AP-1 CRYOTEST STATION
USER MANUAL

FLEXION CORPORATION
SANTA BARBARA CALIFORNIA

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CRYOTEST STATION, MODEL AP-1

SYSTEM OPERATING PROCEDURES CHECK-LIST

FLEXION CORPORATION
427 NORTH NOPAL STREET
SANTA BARBARA, CALIF.
93103, (805) 965-0860

FLEXION CRYOTEST STATION, MODEL AP-1

SYSTEM OPERATING PROCEDURE CHECK-LIST

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SYSTEM OPERATING PROCEDURE CHECK-LIST

The following procedure is intended as a guide to system start-up, operation, and shutdown - assuming that all individual system components have been previously setup, and calibrated where necessary.

If problems occur while using this procedure, consult the document "General System Operation" for guidance. This document, in general, parallels the steps outlined in this procedure - but in more detail, with additional technical information, and with alternate procedures outlined in the event of problems.

START-UP

1. Utilities Check:

1.1. Check that AC power is connected to the system.
1.2. Verify that 'compressed air' is connected to the system, and is set at 90 - 100 psi.
1.3. Check that the 'cryogen exhaust receptacle' is in place.
1.4. Verify that the 'dry nitrogen' (GN2) supply has a 'head' pressure of 15 psi.
1.5. If a LN2 'storage tank' is used, verify that the 'liquid nitrogen' (LN2) supply is set to a 'head' pressure of 15 psi. If a Flexion 'LN2 Head Pressure Regulator' is installed, adjust the regulator valve for a pressure of 15 psi.
1.6. Check that the 'cryogen transfer line' is connected.
1.7. 'Purge' the entire cryogen cooling system with GN2 for one minute - per method outlined in the 'General System Operation' document.
1.8. Check that the GN2 line is connected to the system.
1.9. Check that the 'liquid Nitrogen' (LN2) is connected to the system. DO NOT turn on the LN2 at this point!

2. Power On: (in order indicated)

2.1 Turn ON the 'main power' using the double circuit-breaker located on the system front panel. The red light above the switch should become lit.
2.2 Turn ON the Thermocouple/Ion Gauge Controller.
2.3 Turn ON the two temperature controllers.
2.4 Install the 'AP-1 Program Disk' into the left-hand disk drive (A:) of the HP150 computer, and turn ON the computer.
2.5 Wait for the HP150 to complete its 'power-up checkout and initialization'. Note, the HP150 will NOT successfully complete its 'power-up' checkout unless the temperature controllers are turned on FIRST!

If the HP150 checkout is not successful, DO NOT continue with this procedure. Consult the 'General System Operation' document for guidance.

SYSTEM OPERATING PROCEDURE CHECK-LIST : START-UP (cont.)

3. Initial Setups:

3.1 Move the probes and wafer to their respective 'home' positions. Select the 'XYZ MANUAL MENU' on the HP150 'MAIN MENU'. Select the "GOTO Z POS" function and the "HOMEpos" key to send the probes 'home'. Select the "GOTO XY POS" function and the "HOMEpos" key to move the stage to its 'home' position. Typically, they should already be at their 'home' positions.

DO NOT continue with this procedure if the probes and stage CANNOT be brought to their respective 'home' positions.

3.2 Raise the cover - using the 'COVER' function on the HP150's 'MAIN MENU'
3.3 Open the 'wafer access lid'.
3.4 Install the wafer chuck with the pre-aligned device mounted.
3.5 Align the chuck with the special alignment tool.
3.6 Close the 'wafer access lid' - and SECURE THE HOLD-DOWN LATCH!
3.7 Close the cover.
3.8 Initialize the temperature controllers. Select the 'TEMPERATURE MENU' from the HP150's 'MAIN MENU'. Start the 'initialization' process by using the 'TEMP CTRL #1: INIT' & 'TEMP CTRl #2: INIT' functions on the 'TEMPERATURE MENU' screen and the "START" keys.
3.9 Verify successful completion of the temperature controller 'initialization' process. The legend "INITIALIZED" should be present in the appropriate function blocks on the 'TEMPERATURE MENU' screen.

If the legend "FAILED" is present after the temperature controller 'initialization' process, DO NOT continue with this procedure. Consult the 'General System Operation' document for guidance.

4. Pumpdown:

4.1 Turn ON the mechanical pump. Use the switch on the lower front panel of the system. The red lamp above the switch should become illuminated.
4.2 After 1 minute, turn on the turbo pump. Use the switch on the lower front panel of the system. The red lamp above the switch should become lit.
4.3 Verify that after 5 minutes the 'chamber TC' gauge indicates approximately "0" and the 'foreline TC' gauge is approximately 'mid-scale'.

If after 5 minutes the 'chamber TC' and 'foreline TC' gauges do not read as indicated above, consult the 'General System Operation' document for guidance.

SYSTEM OPERATING PROCEDURE CHECK-LIST : START-UP (cont.)

4. Pumpdown: (cont.)

4.4 Check that the amber lamp above the 'turbo pump' switch becomes lit - which indicates that the turbo pump has achieved its rated rotational speed.

If after 2 minutes the turbo pump does not achieve its rated rotational speed, consult the 'General System Operation' document for guidance.

4.5 Turn ON the 'ion gauge' filament - using the appropriate switch on the pressure controller.
4.6 Read the chamber pressure, as measured by the 'ion gauge' meter. It should ultimately reach at least 5 x 10-4 Torr.

If after 20 minutes the ion gauge has not indicated a pressure less than 5 x 10-4 Torr, consult the 'General System Operation' document for guidance.

5. Cooldown:

5.1 Wait until the Chamber TC pressure has dropped to approximately "0". The cooldown process may then be started.
5.2 Turn on the LN2 supply. Check for a pressure of 15 psi.
5.3 Open the "Probe" and "Stage" cryo metering values, at the front of the system chamber, to a setting of '200' (full open).
5.4 After approximately 5 minutes, 'throttle-down' the "Probe" and "Stage" values to minimize excess LN2 flow from the 'cryo exhaust' line. An ultimate setting of approximately "65" to "85" is typically satisfactory.
5.5 Allow the 'probe' and 'stage' temperatures to drop to below 80 K - regardless of the ultimate low-temperature setpoint. This is necessary to allow other chamber elements, which may substantially 'lag' in their cooldown, to reach low-temperature.

If the probe and stage temperatures do not drop to 80 K within 30 to 40 minutes, typically, consult the 'General System Operation' document for guidance.

5.6 Turn ON the 'temperature regulation process'. Use the 'TEMP CTRL 1:COOL' and the 'TEMP CTRL 2:COOL' functions on the 'TEMPERATURE MENU' to start the regulation process in the temperature controllers.
5.7 Verify that the temperature controller 'power' meters initially indicate "100%". This value should reduce as the temperatures approach the 'low-temperature' setpoint.
5.7 Wait for the temperature to increase to the user-programmed 'low-temperature' setpoint.
5.8 Reduce the "Probe" and "Stage" valve settings to positions which will give sufficient cooling - without introducing temperature drift or instability.

SYSTEM OPERATING PROCEDURE CHECK-LIST : START-UP (cont.)

5. Cooldown: (cont.)

5.9 Adjust the 'Proportional' and/or the 'Integral' setpoints, if necessary, to obtain stable temperature control. Return to the 'MAIN MENU' and use the 'SETPOINT MENU' to change these values.
5.10 Verify that the 'power' meters on the temperature controllers are not indicating more than 50% to 60% after the temperature stabilizes. If not, 'throttle-down' the cryo valves to maintain a 'power' level around 50%.

6. Optical Viewing Setup:

6.1 Turn ON the video monitor.
6.2 Turn ON the camera power using the 'illumination' control.
6.3 Adjust the amount of illumination, as required.
6.4 Adjust the camera focus if necessary - by sliding the camera backward or forward.

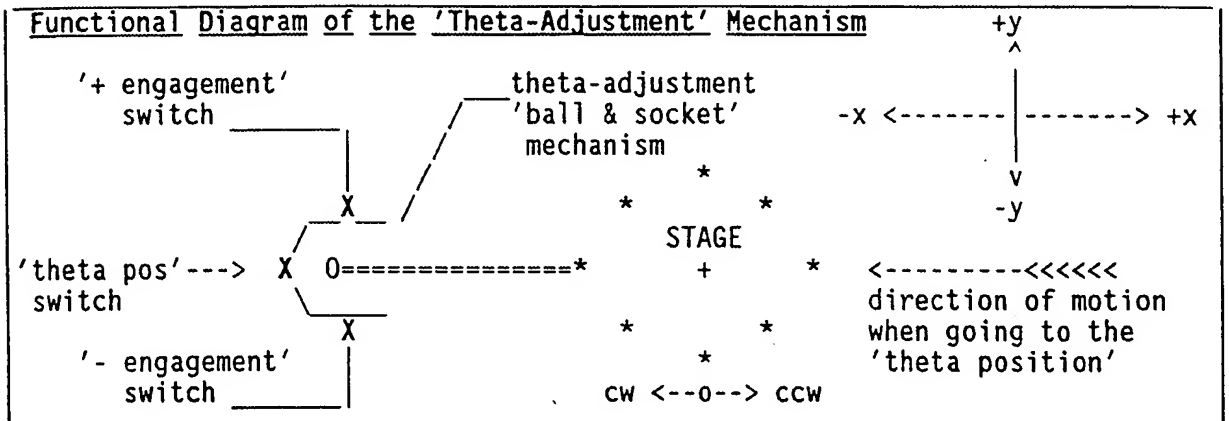
7. Adjusting the 'Angular Mis-alignment' of the Wafer ('Theta Adjust')

7.1 Move the wafer to its 'home position' by using the "GOTO XY POS" function and the "HOMEpos" key on the "XYZ MANUAL MENU".
7.2 Determine the angular mis-alignment of the wafer by slewing it in the x-axis direction - while observing the alignment on the video monitor.
7.3 Move the wafer to its 'theta position' by using the "GOTO XY POS" function and the "to THETA" key.
7.4 Move the wafer to the "+" or "-" engagement point by using the "GOTO XY POS" function and the "+ENGAGE" or "-ENGAGE" key. Note, "+" engagement allows counterclockwise rotation of the wafer, while "-" engagement allows clockwise rotation.
7.5 Step the wafer in the "+" or "-" y-axis direction, in same direction as the engagement 'polarity', to effect a change in the rotational angle of the wafer. Use the "Y AXIS" key and "+STEP" or "-STEP" key, as required. Note, rotation is ONLY effected if the y-axis is stepped in the same direction as the engagement 'polarity'.
7.6 Leave the 'theta position' of the wafer by using the "GOTO XY POS" function and the "lv THETA" key.
7.7 Check the alignment of the wafer by slewing the wafer in the "+" direction of the x-axis while viewing the wafer on the video monitor.
7.8 Repeat steps 7.3 thru 7.7 as required.

SYSTEM OPERATING PROCEDURE CHECK-LIST : START-UP (cont.)

7. Adjusting the 'Angular Mis-alignment' of the Wafer ('Theta Adjust') (cont.)

Functional Diagram of the 'Theta-Adjustment' Mechanism



note: with the 'ball' engaged in the 'socket', the stage will rotate about its center-point when the stage is moved in the y-axis direction.

8. Probe & Wafer Setup:

8.1 Select the 'XYZ MENU' from the HP150's 'MAIN MENU'.
8.2 The stage & probes should already be at their respective 'home' positions.
8.3 Move the wafer to the "die #1 position". Use the x and y-axis 'STEP' and 'SLEW' keys to move the wafer to the required position. Alternately, go to the 'approximate' 'die #1 position' by using the "SET XY POS" function and the "setDIE#1" key, and then the "GOTO XY POS" function and the "DIE#1pos" key.
8.4 Critically position the wafer position for the 'exact' 'die #1 position', using the x and/or y-axis "STEP" keys
8.5 Set the wafer "die #1 position" by using the "SET XY POS" function and the "SET DIE #1" key.
8.6 Move the probes to the 'close' position by using the "GOTO Z POS" function and the "CLOSE" key.
8.7 Activate z-axis stepping & slewing by using the "Z-AXIS" key.
8.8 Step the probes down until the probes just touch the wafer surface.
8.9 Set the probe 'zero position' by using the "SET Z-POS" function and the "setZERO" key.
8.10 Step the probes down, as needed, to guarantee reliable contact for the probe 'test position'.
8.11 Set the probe 'test position' by using the "SET Z-POS" function and the "setTEST" key.
8.12 Step the probes up to a position that will guarantee that the probes will "clear" the wafer surface throughout the entire travel of the stage.
8.13 Set the probe 'clear position' by using the "SET Z-POS" function and the "setCLR" key.

SYSTEM OPERATING PROCEDURE CHECK-LIST

WAFER PROBING

The following procedure is designed as a general guide to moving the wafer and probing the map positions. Note, the wafer may also be moved and probed 'manually' by using the "XYZ MANUAL MENU".

1. Select the 'MAP MOVEMENT MENU' using the "MAP MOVEMENT" key on the HP150 'MAIN MENU'.
2. Move the wafer to the "die #1 position" by using the "WAFER POSITIONS" function and the "DIE#1pos" key.
3. Move the probes to their "test position" by using the "PROBE POSITIONS" function and the "TESTpos" key.
4. Move the wafer to other map positions by using the "ROW SHIFT ±", the "DIE SHIFT ±", or the "ARRAY SHIFT +-" functions and the "START" key. Note, the probes will raise automatically to their 'clear position' - prior to an xy movement.
5. Move the probes down to their 'test position' by using the "TESTpos" key.
6. Operate the 'shutters' by using the "SHUTTERS" function and the appropriate shutter position key.
7. Repeat steps 4 through 6 as required.

HOST CONTROL

The following procedure outlines the general steps required to enter and exit the 'host control' mode. Operation of the AP-1 via a host computer is beyond the scope of this document.

It is assumed that the serial parameters for PORT #2 on the HP150 computer have been set, per instructions given in the document "Procedure for Setting-up the HP150 Computer for Communication with a Host Computer". It is also assumed that an appropriate serial cable is connected between the host computer and the HP150 computer.

1. Enter the "REMOTE MODE MENU" by selecting the "REMOTE CONTROL" function on the HP150 "MAIN MENU".
2. Initiate the 'host control' mode by selecting the "READY FOR TEST" function on the "REMOTE MODE MENU" and the "SEND REQ" key.
3. If the host is 'ready', the 'host control' mode is entered. If the host is 'not ready', the user is returned to the "REMOTE MODE MENU" screen.
4. When the host computer is finished with the system, it will return control back to the HP150.
5. To unilaterally terminate the 'host control' mode, the "EXIT" key on the HP150 screen may be touched.

SYSTEM OPERATING PROCEDURE CHECK-LIST

WARMUP

This procedure is designed to bring a system, which is under vacuum and at a cold temperature, up to an atmospheric and room-temperature condition.

1. Initial Setups:

1.1 Move the probes and wafer to their respective 'home' positions. Select the **'XYZ MANUAL MENU'** on the HP150 **'MAIN MENU'**. Select the **"GOTO Z POS"** function and the **"HOMEpos"** key to send the probes 'home'. Select the **"GOTO XY POS"** function and the **"HOMEpos"** key to move the stage to its 'home' position.

1.2 Turn OFF the ion gauge filament. If the filament light is on, turn the ion gauge off by momentarily toggling the filament switch to the up position.

2. Chamber Heating:

2.1 Turn OFF the liquid nitrogen cooling - using the main LN2 valve to the system.

2.2 Turn the Probe and Stage cryo metering valves to 200 (full-open).

2.3 Purge the system cryo lines with 'dry nitrogen' (GN2). Continue the 'purge' throughout the entire 'warmup' cycle.

2.4 Set the temperature controllers to the 'warmup' mode. Select the **"TEMP CONTROL MENU"** on the HP150 **"MAIN MENU"**. Select the **"TEMP CTRL 1: WARMUP"** function and the **"ON"** key. Select the **"TEMP CTRL 2:WARMUP"** function and the **"ON"** key.

2.5 Turn ON the shield heaters. Select the **"SHIELD HEATERS"** function and the **"ON"** key in the **"TEMP CONTROL MENU"**.

2.6 Wait for all temperatures to reach at least 290 K.

CAUTION: DO NOT PROCEED UNTIL THE SYSTEM TEMPERATURES REACH 290 K ! If the system temperatures do not reach 290 K within 60 minutes, consult the "General System Operation" document for guidance.

2.7 Turn the temperature controllers' 'warmup' mode 'off'. From the **"TEMP CONTROL MENU"**, select the **"TEMP CTRL 1:WARMUP"** function and the **"OFF"** key. Select the **"TEMP CTRL 2:WARMUP"** and the **"OFF"** key.

2.8 Turn OFF the shield heaters. Select the **"SHIELD HEATERS"** function and the **"OFF"** key in the **"TEMP CONTROL MENU"**. Note: the shield heaters will turn off automatically at 300 K (room temperature), however an exit from the **"TEMP CONTROL MENU"** is inhibited until the shield heaters are off!

SYSTEM OPERATING PROCEDURE CHECK-LIST : WARMUP (cont.)

3. Pumping Termination:

3.1 Turn OFF the turbo pump, using the 'on/off' switch on the system front panel. Note, the turbo pump will continue to rotate for a period of time.
3.2 Turn OFF the mechanical pump, using the 'on/off' switch on the front panel.
3.3 Slow down the turbo pump. After waiting at least 3 minutes for the turbo pump to slow down after being turned off, open the 'backfill' valve momentarily - in short bursts. Use the "**BACKFILL VALVE**" function in the "**TEMP CONTROL MENU**" and the "**ON**"/"**OFF**" keys.

4. Chamber Backfill:

4.1 'Backfill the chamber with 'dry nitrogen' (GN2). After waiting at least 10 additional seconds, open the 'backfill' valve - and leave it open. It will be closed automatically when the chamber reaches atmospheric pressure.
4.2 Wait for the chamber to reach atmospheric pressure and the system temperatures to reach 300 K.
4.3 Raise the cover. Exit the "**TEMP CONTROL MENU**" and return to the "**MAIN MENU**". Select the "**COVER**" function and the "**UP**" key.

SYSTEM OPERATING PROCEDURE CHECK-LIST

SYSTEM SHUTDOWN

If the system is to be shut down for any length of time, the chamber should be closed, 'pumped-out' and 'backfilled' with 'dry nitrogen' (GN2) to prevent moisture and atmospheric contamination. In addition, the cryo lines should be 'purged' with 'dry nitrogen'.

If the system is pumped down and cold, fist follow the 'warmup' procedure, as described in the previous section, and remove the 'device-under-test'.

1. Pump-Out and Backfill:

1.1 Lower the cover. Select the "**COVER**" function and the "**DOWN**" key from the HP150 "**MAIN MENU**".
1.2 Turn ON the mechanical pump. Use the switch on the lower front panel of the system. The red lamp above the switch should become lit.
1.3 Turn on the turbo pump AFTER 1 minute. Use the switch on the lower front panel of the system. The red lamp above the switch should become lit.
1.4 Pumpdown the chamber. Allow the chamber to be pumped down to a pressure of 100 microns (1 x 10-1 Torr), as measured by the chamber TC meter.
1.5 Turn OFF the turbo pump, using the 'on/off' switch on the front panel.
1.6 Turn OFF the mechanical pump, using the 'on/off' switch on the front panel.
1.7 Slow down the turbo pump. After waiting at least 3 minutes for the turbo pump to slow down after being turned off, open the 'backfill' valve momentarily - in short bursts. Use the "**BACKFILL VALVE**" function in the "**TEMP CONTROL MENU**" and the "**ON**"/"**OFF**" keys.
1.8 Backfill the chamber with 'dry nitrogen' (GN2). After waiting at least 10 additional seconds, open the 'backfill' valve - and leave it open. It will be closed automatically when the chamber reaches atmospheric pressure.
1.9 Wait for the chamber to reach atmospheric pressure - as indicated by the "**ATMOS. SW: ATMOS**" status in the '**SYSTEM STATUS**' box on "**TEMP CONTROL MENU**"

2. Turning Off the Utilities:

2.1 Check that the liquid nitrogen cooling to the system has been turned OFF. If not, close the LN2 valve to the system.
2.2 Check that the Probe and Stage cryo metering valves have been set to "200" (full-open). If not, set them to "200".
2.4 Turn OFF the 'dry nitrogen' (GN2) supply to the system.
2.5 Turn OFF the 'compressed air' supply to the system.

SYSTEM OPERATING PROCEDURE CHECK-LIST

SYSTEM SHUTDOWN (cont.)

3. Power Off:

3.1 Turn OFF the HP150 computer, using the power switch below the screen.
3.2 Remove the 'AP-1 Program Disk' from the HP150 - and store in a clean, dry, room-temperature, and non-magnetic location.
3.3 Turn OFF the video camera, by rotating the 'illumination' knob counterclockwise to its "0" position.
3.4 Turn OFF the video monitor, using the its front power switch.
3.5 Turn OFF the Thermocouple/Ion Gauge, using the front panel power switch.
3.6 Turn OFF the two temperature controllers, using the front panel power switches.
3.7 Turn OFF the 'main power', using the double circuit-breaker located on the front panel of the system. The red light above the switch should turn off.

SYSTEM OPERATING PROCEDURE CHECK-LIST

POWER FAILURES

1. Effects and Consequences of Momentary Power Failures:

Momentary power failures, which include 'brown-outs' or low-voltage conditions, may occur at any time - with little indication of their occurrence. However, if the HP150 suddenly starts its 'power-up' routine, a momentary power failure or 'brown-out' has most likely occurred.

The following list summaries the effects of a momentary power failure on the AP-1 system - and the direct consequences to the system operator.

1.1 The mechanical pump will continue to run after a momentary power failure.

1.2 The turbo pump, which normally would have to be restarted, will restart automaticaly due to special control circuits in the AP-1 system.

1.3 ALL temporary setpoints (i.e. those changed, but not saved to disk) relating to the 'map configuration', 'temperature controllers', and/or 'probe limits' are LOST during a power failure! These must be re-programmed in the "**SETPOINT MENU**".

1.4 ALL setpoints previously 'downloaded' to the temperature controllers are lost during a power failure! These include the '**proportional**' and '**integral**' setpoints, and the '**low temperature**' setpoint. These setpoints must be 'downloaded' again to the temperature controllers by performing the 'temperature controller initialization' process in the "**TEMP CONTROL MENU**".

1.5 The temperature controllers go to an 'off' state after a power failure, and cease to regulate the system temperature. The temperature controllers must be set to the 'temperature regulation mode' again by activating the "**TEMP #1 & #2: COOL**" functions in the "**TEMP CONTROL MENU**".

1.6 The probe '**clear**', '**zero**', and '**test position**' settings are lost during a power failure - and have to be re-established in the "**XYZ MANUAL MENU**". These should be reset AFTER the low temperature is re-established and stabilized.

1.7 The wafer '**die #1 position**' setting is lost during a power failure - and must be reset in the "**XYZ MANUAL MENU**". This should be reset AFTER the low temperature is re-established and stabilized.

1.8 The HP150 will perform its 'power-up initialization' automatically upon resumption of power.

SYSTEM OPERATING PROCEDURE CHECK-LIST

POWER FAILURES (cont.)

2. Long Term Power Failures:

If the AC power has been off for an extended period of time, and is not expected to be re-established in the near-term, and a complete 'power-down' condition is desired upon resumption of power, then the following steps should be taken.

When AC power is again available, follow the steps outlined in the 'START-UP' procedure to bring the system back to an operating condition.

2.1 Turn OFF the turbo pump, using the switch on the system front panel.
2.2 Turn OFF the 'main system power', using the double circuit-breaker located on the system front panel.
2.3 Turn OFF the mechanical pump, using the switch on the system front panel.
2.4 Turn OFF the HP150 computer, using the power switch below the screen.
2.5 Remove the 'AP-1 Program Disk' from the HP150.
2.6 Turn OFF the video camera, by rotating the 'illumination' knob counterclockwise to its "0" position.
2.7 Turn OFF the video monitor, using the its front power switch.
2.8 Turn OFF the Thermocouple/Ion Gauge, using its front panel power switch.
2.9 Turn OFF the two temperature controllers, using their front panel power switches.
2.10 Turn OFF the 'liquid nitrogen' (LN2) supply to the system.
2.11 Set the Probe and Stage cryo metering valves to "200" (full open).
2.12 Purge the system cryo lines with 'dry nitrogen' (GN2).
2.13 Turn OFF the 'dry nitrogen' (GN2) supply to the system.
2.14 Turn OFF the 'compressed air' supply to the system.

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HP150 OPERATIONAL MANUAL

FLEXION CORPORATION

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93103, (805) 965-0860

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SOFTWARE CONFIGURATION VIA THE "USER-PROGRAMMABLE" FILES

There are a number of disk files whose content controls the software configuration. This configuration relates mainly to print-outs, temperature controller setpoints, probe limits, and map configuration. These files are "data" files which are ASCII compatible, i.e. they are composed of the "normal" letters, numbers, and punctuation marks. They are produced using any word processor that can make ASCII compatible files. They may also be produced using the "copy con: < file name>" method from MS-DOS. This method will be explained below.

In general, these files do not need to be changed. The software is preconfigured prior to shipment. However, if the requirements change, the software may be reconfigured.

The configuration files have interrelating values, therefore care must be taken when any of these files is changed so that ALL appropriate values are changed. It is suggested that before a file is changed it is saved in a "backup" file or on a "backup" disk in case there is a need to retrieve it later.

The following sections list the various "user-programmable" configuration files and an explanation of the various "flags" and settings contained in each file.

SOFTWARE FLAGS FILE

This file contains the software configuration parameters, commonly called "software flags". The name of this file is "SW-FLAGS.00". The settings of these flags and a brief explanation of their use is automatically printed out during the execution of the "setup" program (unless the "quick-execution" feature is allowed to become active, see note 1).

1. **"Print.sp"** - Setting this flag to a value of "1" will cause the "setup" program to print the "setpoint" values contained in the "SP.01" file to an external printer. A setting of "0" will inhibit this printout. These values are those setpoints associated with the temperature controllers and the map configuration (see explanation of the setpoints in a following section).

2. **"Print.map"** - A setting of "1" will enable the printout of the map coordinate values for the x,y, array, and z axes. A setting of "0" will disable this printout.

Note (1): The "quick-execution" feature will automatically become active upon execution of the "setup" program unless the user "cancels" this feature by touching the <FULL> key on the crt screen. The "quick execution" feature basically inhibits most print-outs during "setup" program execution - thus 'speeding up' the program execution time.

SOFTWARE CONFIGURATION VIA THE "USER-PROGRAMMABLE" FILES (continued)

3. **"Prt.out"** - A setting of "1" will enable printout in general, that is printout will be enabled whenever the software would normally print. A setting of "0" will disable any printout. This flag does not affect printouts during the execution of the "setup program" or when there is a serious fault in the system operation.

4. **"Temp.prt"** - A setting of "1" will enable the printout of temperature versus time when in the "temperature control" menu. That is, during the "cool-down" or "warm-up" cycles. A setting of "0" will disable this printout.

5. **"Sensor.1A.id"** - The setting of this flag determines the "curve" used in temperature controller #1, sensor A. A setting of "00" selects curve "DRC-D", a setting of "10" selects curve "DRC-E1", and a setting of "20" selects curve "CRV-10", a setting of "30" selects curve "DIN-PT", and a setting of "40" selects the "precision diode option" if model 'DRC-81C', else a setting "40" selects the "extended CRV-10" if model 805.

6. **"Sensor.2A.id"** - The setting of this flag determines the "curve" used in temperature controller #2, sensor A.

7. **"Sensor.1B.id"** - The setting of this flag determines the "curve" used in temperature controller #1, sensor B.

8. **"Sensor.2B.id"** - The setting of this flag determines the "curve" used in temperature controller #2, sensor B.

9. **"Just.touch"** - A setting of "1" enables the 'internal' "just-touching" input and the corresponding function in the "XYZ" and "MAP" menus. If this flag is set to "1", the "just-touching" input MUST be active and the wafer properly positioned, if not, the probes may CRASH into the wafer surface when the corresponding function is activated. IF the appropriate software version is installed, a setting of "2" for this flag will enable the functionally similiar 'external' "just-touching" input, and a setting of "3" will enable both inputs.

10. **"Perim.pads"** - In general, this flag should always be set to "0" - except in the case of a device that has probe positions (i.e. pads) along its four sides. In this case, it should be set to a "1". (see separate explanation)

11. "Spare" - This is a reserved software flag which MUST be set to "0". This flag is used to enable the use of a special "SW-TEST" file, which is used for test purposes.

12. **"Auto.goto.test"** - A setting of "1" will cause the probes to automatically go to the "test position" after a move to a specific map position during "host control". A setting of "0" will require the host to issue a separate command to initiate movement to the probe "test position".

SOFTWARE CONFIGURATION VIA THE "USER-PROGRAMMABLE" FILES (continued)

13. "Random.array.map" - A setting of "1" indicates to the software that the array map is resident in a separate file on the disk and is NOT to be produced during "setup" program execution using the "number of arrays" and the "array increment" setpoints contained in the "setpoint" file "SP.01".

When the "setup program" produces the array map, the array elements are EQUALLY SPACED. Therefore, if array elements are not necessarily equally spaced, i.e. "randomly" spaced, a setting of "1" for this flag should be made. If a setting of "1" is made, the user MUST produce the appropriate array coordinate file. The name of this file MUST be "ARRYMAP.00". The production of this map is explained in a later section.

Note, the user MUST still set the "number of arrays" setpoint in the "setpoint" file "SP.01" to the appropriate value. In addition, whenever a "random" array map is selected, the user is prohibited from changing the array-related setpoints using the "setpoint" menu facilities.

The normal setting of this flag is "0". This should be the setting if the array can be completely specified by the "distance between arrays" and by the "number of arrays" setpoints.

14. "Random.die.map" - A setting of "1" indicates to the software that the xy maps are resident in separate files on the disk and are NOT produced using the map configuration setpoints contained in the "setpoint" file "SP-01" during execution of the "setup program".

When the "setup program" produces the die maps, the dies have EQUAL SPACING along each axis. Therefore, if dies are not necessarily equally spaced, i.e. "randomly" spaced, a setting of "1" for this flag should be made.

If a setting of "1" is made, the user MUST produce x-axis and y-axis coordinate maps. The names of these maps must be "XDIEMAP.00" and "YDIEMAP.00" respectively. The production of these maps is explained in a later section.

The user MUST still set the "number of dies in the x-axis" and the "number of dies in the y-axis" setpoints. Whenever a "random" xy map configuration is selected, the user is prohibited from changing any of the xy map configuration setpoints using the "setpoint" menu facilities.

In addition, with "random" maps, the user should enter coordinate values for the default "die #1 position" into the "DIE1POS.00" file.

SOFTWARE CONFIGURATION VIA THE "USER-PROGRAMMABLE" FILES (continued)

The normal setting of the "random.die.map" flag is a "0". It should be set to "0" if there is a map configuration that has die positions spaced throughout the wafer (or chip) in a "uniform" manner - such that the map configuration can be completely specified by the following parameters:

a) distance between dies, x-axis
b) distance between dies, y-axis
c) number of dies, x-axis
d) number of dies, y-axis

15. "Test/die" - A setting of "1" will cause the software to refer to each specific map location as a "test" position. A setting of "0" will cause reference to these locations as a "die" position. If the "array total" setpoint = "0" (i.e. no arrays), the value of this software flag may be set as desired. However, if the "array total" setpoint value is greater than zero, the value for this software flag MUST be set to "0" (i.e. "die" labels).

16. "Z.map" - Setting of "1" enables the use of a special "z-axis offset " coordinate file "ZDIEMAP.00". The values in this file correspond to the z-axis offset applied to the probe "clear", "zero", and "test" positions for each specific xy map position. . This offset is applied automatically whenever this flag is set to "1". The user MUST produce this file if the "z.map" parameter is set to "1". A setting of "0" disables this function. In addition, whenever the "z.map" is selected, the user is prohibited from changing any of the xy map configuration setpoints using the "setpoint" menu.

17. "TEMP.MODEL" - A setting of "1" will cause the software to assume two Lake Shore, Model 805 temperature controllers are connected to the HP150 via the HPIB bus. A setting of "0" will indicate Lake Shore, Model DRC-81C temperature controllers. The Model 805 has replaced the Model DRC-81C. The two models are very similar from a functional viewpoint. However, due to a number of differences, especially with respect to the remote command structure, the AP-1 program must know which model is connected.

EXAMINING AND PRODUCING THE "SOFTWARE FLAGS" FILE ("SW-FLAGS.00")

The contents of a typical "software flag" file would look as follows:

1,1,1,1,90,70,40,40,0,0,0,1,1,1,0,1,1

In this example the software flags are separated by commas. They could have also been separated by "carriage returns", in which case the software flags would be listed in a "vertical" column.

The contents of the software flag file may be examined using any standard word processor or using the MS-DOS "type" command. That is, after the MS-DOS prompt "A>" the following is entered:

A> type B:SW-FLAGS.00 [return]

EXAMINING AND PRODUCING THE "SOFTWARE FLAGS" FILE (con't.)

The contents of this file will then be displayed as shown above on the crt screen. Note, the disk containing the "software flags" file is assumed to be in drive B. To produce the "software-flags" file using MS-DOS facilities, the "copy con:" command is used. That is, after the MS-DOS prompt "A>" the following is typed:

A> copy con: B:SW-FLAGS.00 [return]

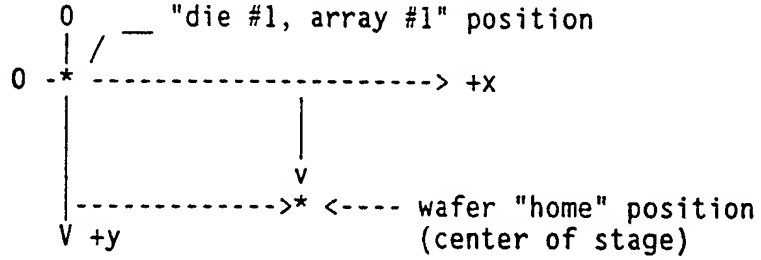
Then the value for each flag is typed in sequence, as follows:

1,1,1,1,90,70,40,40,0,0,0,1,1,1,0,1,1

A [control - z] and then a [return] key will initiate the saving of this file on drive B.

THE "DIE #1 POSITION" FILE ("DIE1POS.00")

This file, which is only used when there are 'random die maps', contains the map coordinate values of the initial default "die #1, array #1" position. This position is the number of steps from the "die #1, array #1" position to the stage "home" position. The wafer should be placed on the stage so that the "die #1, array #1" position is at the top-left corner of the stage. With this being true, the coordinate numbers will be both positive. The diagram shown below indicates the coordinate system for the numbers in this file.



If the "die #1, array #1" position is unknown, then "0" should be entered for the two coordinate values. This will put the "die #1, array #1" position at the wafer "home" position - which is a "safe" position.

The first entry in this file is a user-supplied "identification number". The second entry is the x-axis coordinate value of the "die #1, array #1" position. The third entry is the y-axis coordinate value. All entries must be less than 32000 in absolute value.

An example of the "DIE1POS.00" file is shown below:

687,3281,4827 where 687 = identification number
3281 = x-coordinate value
4827 = y-coordinate value

THE "SETPOINT" FILE

This file contains setpoints for the two temperature controllers and the parameters of the map configuration. The name of this file is "SP.01".

The contents of this file, with the name of each setpoint, is printed out during the execution of the "setup" program if the "print.sp" software flag is set to "1", and the "quick execution" feature has not been enabled.

The value for these setpoints may also be changed within the the "setpoint" menu. If these setpoints are "saved" while in the setpoint menu, the values will be "permanently" stored in the "SP.01" file on the A-drive disk. It should be noted that, when the HP150 is powered up, the program uses the values contained in this file for the "initial" values of these parameters.

The following is a list of the setpoints contained in this file that relate to the temperature controllers.

1. Temperature controller #1 "control" setpoint - this value corresponds to the "low temperature" setpoint of the system. The entry should be of the form XXX.X, where the lower limit is 0.1 and the upper limit is 400.0.

2. Temperature controller #1 "proportional" setpoint. The value for this setpoint may range from 00 to 99 (model DRC-81c) or 0.1 to 99 (model 805).

3. Temperature controller #1 "integral setpoint". The value for this setpoint may range from 00 to 99 (model DRC-81c) or 0.1 to 99 (model 805).

4. Temperature controller #1 "derivative" setpoint. The value for this setpoint may range from 00 to 99. (model DRC-81C ONLY).

5. Temperature controller #1 "cool power range". This setpoint MUST have a value of "3" for 'Model 805' ("1" for model DRC-81C).

6. Temperature controller #1 "heat power range". This setpoint MUST have a value of "3" for 'Model 805' ("1" for model DRC-81C).

7. Temperature controller #2 "control" setpoint - this value corresponds to the "low temperature" setpoint of the system. The entry should be of the form XXX.X, where the lower limit is 0.1 and the upper limit is 400.0.

8. Temperature controller #2 "proportional" setpoint. The value for this setpoint may range from 00 to 99 (model DRC-81c) or 0.1 to 99 (model 805).

9. Temperature controller #2 "integral setpoint". The value for this setpoint may range from 00 to 99 (model DRC-81c) or 0.1 to 99 (model 805).

10. Temperature controller #2 "derivative" setpoint. The value for this setpoint may range from 00 to 99. (model DRC-81c ONLY)

SOFTWARE CONFIGURATION VIA THE "USER-PROGRAMMABLE" FILES (continued)

THE "SETPOINT" FILE (cont.)

11. Temperature controller #2 "cool power range". This setpoint MUST have a value of "3" for 'Model 805' ("1" for model DRC-81C).

12. Temperature controller #2 "heat power range". This setpoint MUST have a value of "3" for 'Model 805' ("1" for model DRC-81C).

13. "Access code" - this setpoint corresponds to the "secret" code that is required while in the "setpoint" menu before any change to the setpoints is allowed. The value of the setpoint may range from 0 to 9999.

Map Configuration Setpoints:

The following is a list of the parameters contained in the "setpoint" file that relate to the map configuration. VALUES FOR THESE PARAMETERS MUST STILL BE ENTERED EVEN THOUGH THE "RANDOM" MAP COORDINATE FILES ARE USED.

14. "The distance between map positions in the x-axis" parameter - This parameter determines the number of steps between each "die" or "test" position along the x-axis direction. This parameter is not used whenever a "random" xy map configuration is selected. However, one MUST always enter a value for this parameter to "hold" its place. The maximum value for this parameter is 9999 steps and the minimum value is 1.

15. "The distance between map positions in the y-axis" parameter - This parameter determines the number of steps between each "die" or "test" position along the y-axis direction. This parameter is not used whenever a "random" xy map configuration is selected. However, one MUST always enter a value for this parameter to "hold" its place. The maximum value for this parameter is 9999 steps and the minimum value is 1.

16. "The number of map positions in the x-axis" parameter - This parameter determines the number of "die" or "test" positions along the x axis. This number is exclusive of the number of "arrays" or sub-positions within each "die" position. THIS PARAMETER MUST ALWAYS BE ENTERED - EVEN IN THE CASE OF A "RANDOM" MAP CONFIGURATION. The maximum value for this parameter is 99 and the minimum value is 1. The product of this number times the "number of map positions in the y-axis" MUST NOT exceed 500 (i.e. maximum number of dies).

17. "The number of map positions in the y-axis" parameter - This parameter determines the number of "die" or "test" positions along the y-axis. THIS PARAMETER MUST ALWAYS BE ENTERED - EVEN IN THE CASE OF A "RANDOM" MAP CONFIGURATION. The maximum value for this parameter is 99 and the minimum value is 1. The product of this number times the "number of map positions in the x-axis" MUST NOT exceed 500 (i.e. maximum number of dies).

SOFTWARE CONFIGURATION VIA THE "USER-PROGRAMMABLE" FILES (continued)

THE "SETPOINT" FILE (cont.)

18. "The distance between arrays" parameter - This parameter determines the number of steps between "sub-position" within each "die". The maximum number of steps allowed is 999 and the minimum number of steps is 1. A value for this parameter MUST always be entered. In the case of a "random" array map, where this parameter is not used, the entry of a value simply holds the "place" of this parameter in the list of parameters. The product of this number times the "number of arrays" MUST NOT exceed the "distance between map positions in the x-axis" (i.e. arrays must be within the dies).

19. "The number of arrays within each die" parameter - The value of this parameter determines the number of "sub-positions" within each "die". A value for this parameter MUST always be entered. If there are no "arrays" within each die, the value for this parameter must be set to "0" (zero). With a "0" entered, the user is inhibited from entering a different value when in the "setpoint" menu. In addition, a value of "0" will cause the "map" menu display to delete all references to "array" positions. If the user anticipates a need for "arrays" in the future but wants to indicate that there are no "arrays" initially, a value of "1" should be entered for this parameter. A value of "1" will allow the user to change the value of this parameter in the "setpoint" menu. In addition, a value of "1" or greater will cause the "map" menu display to include all standard references to the "array" positions. The maximum number of arrays within each map position is limited to 999. The product of this number times the "distance between arrays" MUST NOT exceed the "distance between map positions in the x-axis" (i.e. arrays must be within the dies).

20. The setpoint associated with this position is "reserved" and should always be set to "0" in the 'standard' version.

IF the appropriate software version is installed, this setpoint becomes the "The probe 'MAXIMUM OVER-TRAVEL' parameter. This parameter specifies the maximum number of steps that the probes may travel below the 'just-touching' position. The maximum setting for this parameter is 50 steps.

21. "The probe 'MINIMUM-CLEAR' position" parameter - This parameter specifies the smallest value that the operator is allowed to "set" for the probe "clear" position when in the "XYZ MENU". The value entered for this parameter must be greater than or equal to 100 steps. The maximum value must be less than 500.

22. "The probe 'CLOSE' position" parameter - This parameter specifies the initial number of steps down from the "home position" that corresponds to the user-settable "close" position. EXTREME CARE MUST BE TAKEN WHEN ENTERING THIS VALUE SO THAT THE ENTERED VALUE DOES NOT REPRESENT A POSITION THAT IS AT OR BELOW THE WAFER SURFACE! If in doubt, a value of 500 steps should be entered for this parameter. The "xyz manual move" menu can be used to establish the appropriate "close" position. The value of this position can then be changed in the "setpoint" menu.

SOFTWARE CONFIGURATION VIA THE "USER-PROGRAMMABLE" FILES (continued)

THE SETPOINT FILES (cont.)

23. **"The probe 'MAX-DOWN' position " parameter** - This parameter specifies the maximum number of steps down from the "home position" that the probe assembly is allowed to travel . EXTREME CARE MUST BE TAKEN WHEN ENTERING THIS VALUE SO THAT THE ENTERED VALUE DOES NOT REPRESENT A POSITION THAT IS AT OR BELOW THE WAFER SURFACE! If in doubt, a value of 500 steps should be entered for this parameter. The "xyz manual move" menu can be used to establish the appropriate "MAX-DOWN" position. The value of this position can then be changed in the "setpoint" menu.

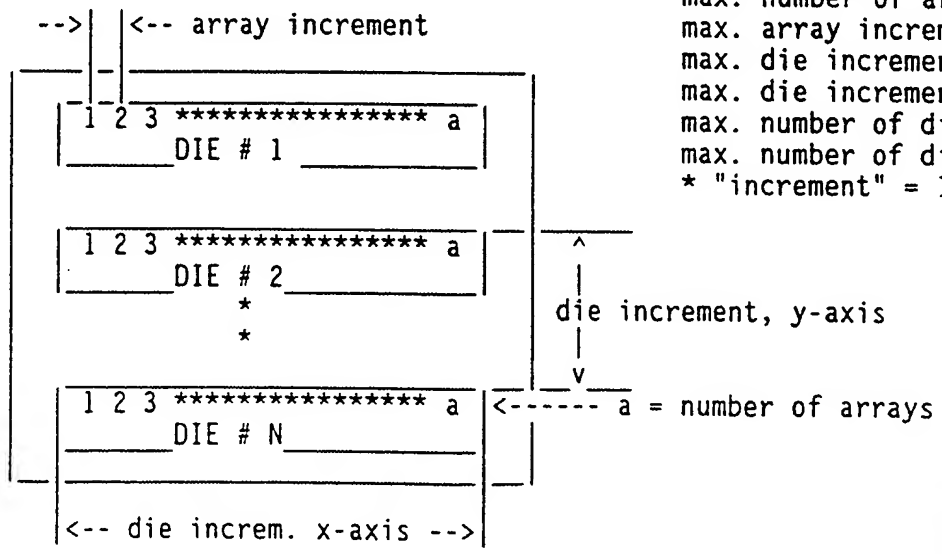
24. The setpoint associated with this position is "reserved" and should always be set to "0".

The examination, change or production of the "setpoint" file "SP.01" is performed similarly to the methods described above for the "software flags" file. That is, by using MS-DOS commands, or a word-processor that can produce ASCII files.

STANDARD MAP CONFIGURATION TYPES: SETPOINTS & DIMENSION DIAGRAMS

The following diagrams outline the details associated with the two types of "standard" configurations, & their associated setpoints.

Map type #1: (one dimensional)
(array direction: x-axis only)



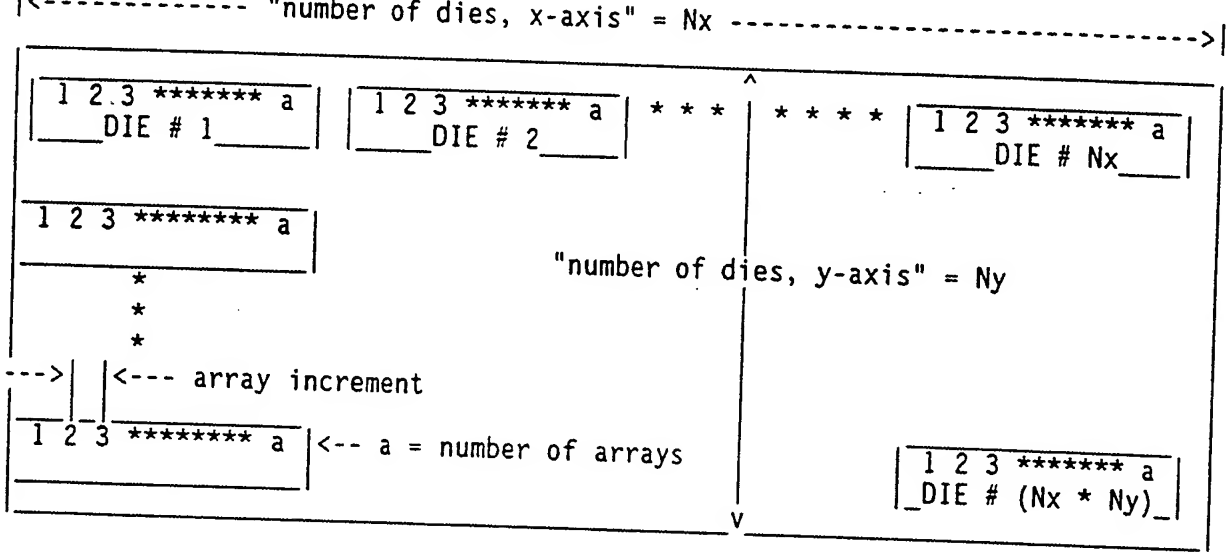
Setpoint Limits: *see note
max. number of dies = 500
max. number of arrays = 999
max. array increment = 999
max. die increment, x-axis = 9999
max. die increment, y-axis = 9999
max. number of dies, x-axis = 99
max. number of dies, y-axis = 99
* "increment" = 1 step = 0.0001 "

SOFTWARE CONFIGURATION VIA THE "USER-PROGRAMMABLE" FILES (continued)

DIMENSION DIAGRAMS : MAP CONFIGURATION SETPOINTS (cont.)

Map type #2: (two dimensional) (array direction: x-axis only)

Setpoint Limits: * see note
max. number of dies, y-axis = 99
max. number of dies, x-axis = 99
max. die increment, x-axis = 9999
max. die increment, y-axis = 9999
max. array increment = 999
max. number of arrays = 999
max. number of total dies = 500
* "increment" = 1 step = 0.0001 "



THE MAP COORDINATE FILES

These files contain the coordinate values of the xy map, the z offset map, and the array map. The names of these maps MUST be "XDIEMAP.00", "YDIEMAP.00", "ZDIEMAP.00", and "ARRYMAP.00" respectively. These maps are produced using any standard word processor with ASCII file capability or with the MS-DOS "copy con:" command as described above.

The "XDIEMAP.00" and the "YDIEMAP.00" files contain the map coordinate values along the x and y axes. The values in these maps MUST be numbers less than 32,767 and contain NO decimal points, i.e. they must be integers. The values in these maps represent the number of steps along the x and y-axis for each map position from a reference point at the top left hand corner of the wafer (i.e., from the "die #1, array #1" position). When the "random die map" flag is set to "1", care must be taken to not only produce the x and y map files, but to correctly program the associated map parameter setpoints in the "SP.01" file. That is, the "number of map positions in the x-axis" and the "number of map positions in the y-axis" setpoints must be appropriately set. It should be noted that when the "random die map" flag is set to "1", the user can not change these two setpoints using the "setpoint" menu.

SOFTWARE CONFIGURATION VIA THE "USER-PROGRAMMABLE" FILES (continued)

THE MAP COORDINATE FILES (cont.)

The "ARRYMAP.00" file contains the array coordinate values, along the x-axis direction, within each die. The values in this map MUST be positive numbers less than 32,767. The values MUST NOT contain a decimal point, i.e. they must be integers. The values in this map represent the number of steps along the x-axis within each die from a reference point at the left side (-x axis direction) of the die.

When a "random array map" is enabled, care must be taken to correctly program the associated map coordinate setpoint in the "SP.01" file. That is, the "number of array positions" setpoint MUST be appropriately set. It should be noted that when the "random array map" flag is set to "1", the user can not change this setpoint using the "setpoint" menu.

The "ZDIEMAP.00" file contains the z-axis offset values for each map position. These values are the number of steps that will be ADDED automatically in the DOWNWARD direction to the "zero" and "test" probe positions. It must be pointed out that, whenever the "z-map" is enabled, these three probe positions may only be set when the wafer is at the "die #1" or "TP #1" position. Therefore, the zero reference point for the values contained in the "z-map" is the z-axis elevation of the "die #1" or "TP #1" position. That is, the value in the "z-map" for this position is equal to zero.

The values contained in this map are typically positive numbers. Negative numbers will have the effect of "raising" the net "zero" and "test" positions.

The z-axis map will be active whenever the "z-map" software flag is set to "1". EXTREME CARE MUST BE TAKEN WHEN ENTERING VALUES INTO THIS FILE SO THAT NONE OF THE ENTRIES WILL CAUSE A DISPLACEMENT OF THE PROBE ASSEMBLY TO A POSITION BELOW THE WAFER SURFACE!

THE "DIE #1 POSITION" MAP

This file "DIE1POS.00" contains the map coordinate values of the initial default "die #1, array #1" position. This file MUST be programmed whenever the "random die map" is enabled. For "normal" maps, this file is ignored. This file has been explained in a previous section.

FORMAT OF THE MAP COORDINATE FILES

With respect to the map configuration files indicated in the previous section, the first entry in each file is reserved for a user-selected "i.d." number. Therefore, the first position after this number is the coordinate of the first map location, the second position after the "i.d." number is the coordinate of the second map location, etc.

SOFTWARE CONFIGURATION VIA THE "USER-PROGRAMMABLE" FILES (continued)

EXAMPLE #1: RANDOM XY MAPS, "TEST" POSITION LABELS, Z MAP ENABLED

The following is an example to show the settings of the "software flags" file and the "setpoint" file for an application requiring "random" x-axis and y-axis map coordinates. This example also includes the use of the optional probe z-offset map. In addition, this example does NOT have "arrays"; and each specific map location is called a "test" position.

Software flags

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
-,	-,	-,	-,	-,	-,	-,	-,	-,	0,	-,	-,	0,	1,	1,	1,	-

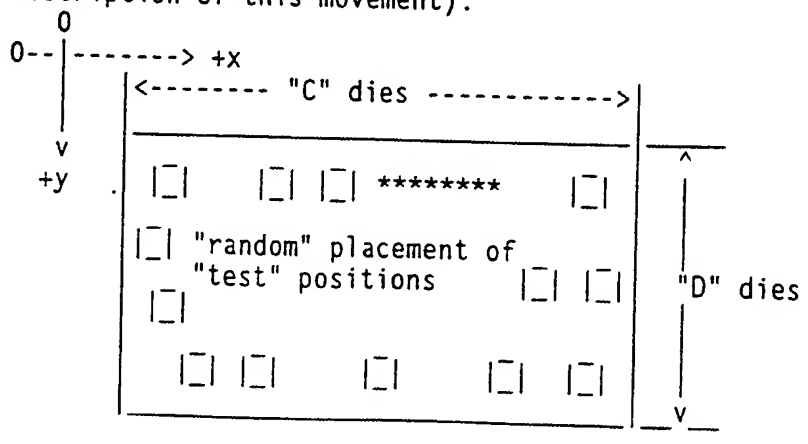
- = not applicable to map configuration
Flag #10 = "perimeter pad" configuration disabled
Flag #13 = "random" array map disabled
Flag #14 = "random" xy map enabled
Flag #15 = "test" position labels selected
Flag #16 = "z-map" enabled

Setpoint file

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
-,	-,	-,	-,	-,	-,	-,	-,	-,	-,	-,	-,	-,	z,	z,	C,	D,	z,	0,	-,	-,	-,	-,	-

- = not applicable to map configuration
z = value not used in this setup, may be any value (preferably 0)
Flag #16 = number of map positions in the x-axis (C) * see note
Flag #17 = number of map positions in the y-axis (D) * see note
Flag #19 = number of array positions (zero, i.e. "none")

* note : For "random" xy maps, the number of the map positions in the x & y axis directions (C & D) may be any value - as long as C x D equals the total number of "test" positions. These two entries establish the map "matrix" for "POSITION" to "position" movement while in the "map" menu (see the "MAP MENU" document for a description of this movement).



SOFTWARE CONFIGURATION VIA THE "USER-PROGRAMMABLE" FILES (continued)

EXAMPLE #2: UNIFORM XY AND ARRAY MAPS, "DIE/ARRAY" LABELS, "PROGRAMMABLE"

The following is an example to show the settings of the "software flags" file and the "setpoint" file for an application requiring uniform, "programmable" x-axis, y-axis, and array map coordinate files. This example does NOT include the use of the optional probe z-offset map. In addition, this example refers to each specific map location as a "die" position. The "sub-positions" within each die are referred to as "array" positions. The settings indicated below will produce a default map configuration that is "programmable", i.e. able to be changed using the "setpoint" menu.

Software flags

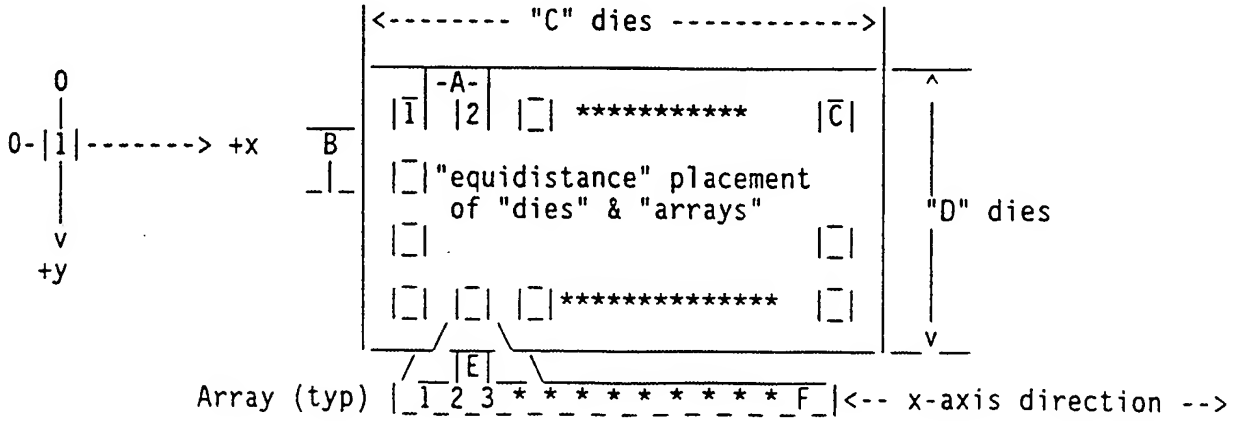
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17
-, -, -, -, -, -, -, -, -, 0, -, -, 0, 0, 0, 0, -

- = not applicable to map configuration
Flag #10 = "perimeter pad" configuration disabled
Flag #13 = "random" array map disabled
Flag #14 = "random" xy map disabled
Flag #15 = "die" position labels selected
Flag #16 = "z-map" disabled

Setpoint file

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
-, -, -, -, -, -, -, -, -, -, -, -, -, A, B, C, D, E, F, -, -, -, -, -

- = not applicable to map configuration
Flag #14 = distance between map positions in number of steps, x-axis (A)
Flag #15 = distance between map positions in number of steps, y-axis (B)
Flag #16 = number of map positions in the x-axis (C)
Flag #17 = number of map positions in the y-axis (D)
Flag #18 = distance between array elements in number of steps (E)
Flag #19 = number of array positions (F) (> 1)

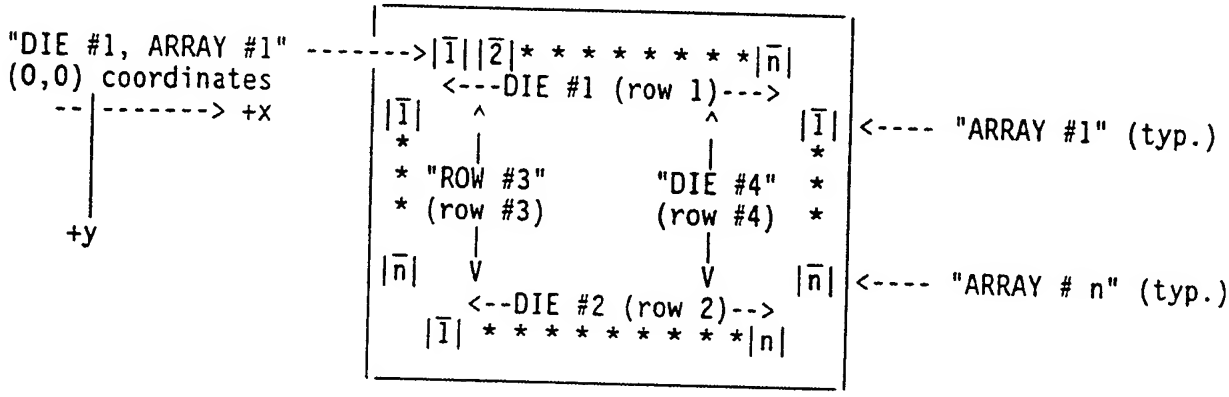


SOFTWARE CONFIGURATION VIA THE "USER-PROGRAMMABLE" FILES (continued)

PERIMETER PAD CONFIGURATION:

The "perimeter pads" flag in the "software-flags" files should be set to "1" when a device has rows of probe positions (i.e. pads) along its four sides. There may be more than one row of pads along each side.

When the "perimeter pads" flag is set to "1", the software assumes that each row of pads corresponds to a "die", & that the pads within each row correspond to "array positions". The following diagram shows the numbering conventions.



All horizontal rows MUST be numbered with the lower-half of the die numbers. All vertical rows MUST be numbered with the higher numbered dies.

The arrays (i.e. pads) MUST be numbered from left to right for those arrays in the horizontal rows, & top to bottom for those in the vertical rows.

Data in the x-axis, y-axis, & array coordinate map files is arranged identical to that required for a "standard" map.

Whenever the "perimeter pads" flag is set to "1", the "random.die.map" flag MUST be set to "1" .The "test/die" flag should be set to "0" also. In addition, because the die map is "random", the coordinates of the "die #1,array #1" position MUST be entered into the "DIE1POS.00" file.

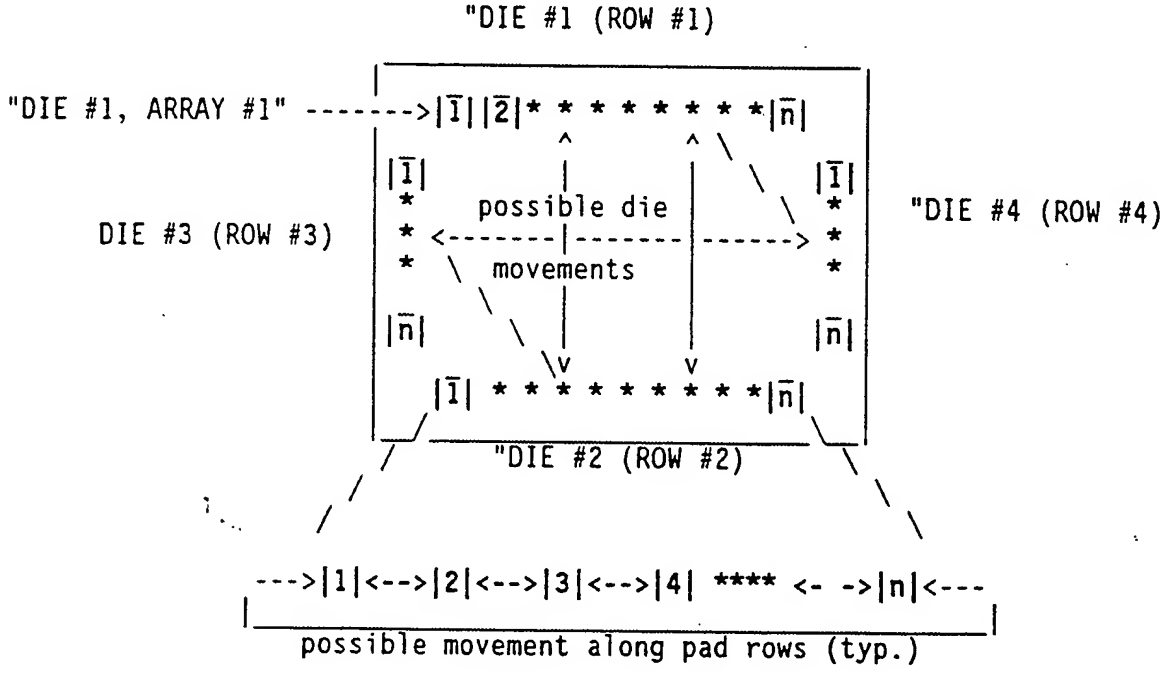
If the spacing between all arrays (pad positions) is identical, then the array map may be automatically produced by the AP-1 program by setting the "random.array.map" flag = "0" (i.e. no random map). Values for the "number of arrays" and the "array increment" setpoints MUST then be entered into the "SP.01" file.

SOFTWARE CONFIGURATION VIA THE "USER-PROGRAMMABLE" FILES (continued)

PERIMETER PAD CONFIGURATION: (cont.)

For a "perimeter pads" map configuration, the "number of dies, x-axis" setpoint MUST be set to "1" and the "number of dies, y-axis" setpoint set equal to the total number of dies (i.e. total number of rows). In addition, the total length of the dies (i.e. length of the rows in number of steps) MUST be entered into the "die increment, x-axis" setpoint. Note, it is assumed that all pad rows have the same length.

With the values indicated above entered into the "SP.01" setpoint file, the "MAP MOVEMENT MENU" will equate die # n with row # n, and it will allow map movement in the following general directions:



A detailed programming example of this type of device and the required file setup is shown in "Example #3 below.

SOFTWARE CONFIGURATION VIA THE "USER-PROGRAMMABLE" FILES (continued)

EXAMPLE #3: PERIMETER PADS CONFIGURATION

The following is an example to show the settings of the "software flags" file & the "setpoint" file for an application that requires a configuration having rows of pads of equal spacing, along each of its sides. This configuration uses "dies" to indicate the rows and "arrays" to indicate the pad positions. (see diagram above). It uses a "random" xy map for the "die" positions. It uses the "array increment" & the "number of arrays" setpoints to define the array map (i.e. the pad positions along the rows).

Software Flags:

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
-	-	-	-	-	-	-	-	-	1	-	-	0	1	0	0	-

- = not applicable to map configuration
flag #10 = "perimeter pads" configuration enabled
flag #13 = "random" array map disabled
flag #14 = "random" xy map enabled
flag #15 = "die" POSITION labels selected
flag #16 = "z-map" disabled

Setpoint File

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
-	-	-	-	-	-	-	-	-	-	-	-	-	A	z	1	D	E	F	-	-	-	-	-

- = not applicable to map configuration
z = value not used in this setup, may be any value, preferably 0
flag #14 = total length of pad rows (A), in number of steps.
flag #16 = number of map positions, x-axis (MUST be set = 1)
flag #17 = number of map positions, y-axis (D) (must be set equal to the total number of dies, i.e. number of rows)
flag #18 = distance between arrays (E) (i.e. distance between pad centerlines, in number of steps)
flag #19 = number of arrays (F) (i.e. number of pads/row)

SOFTWARE CONFIGURATION VIA THE "USER-PROGRAMMABLE" FILES (continued)

'HEADER' FILES

There are a number of user-programmable files that are used as a source of data for a "header" that is attached to the beginning of the various printouts and included at the top of the crt menu displays.

There are three 'header' files. They contain the customer's "company name", the "device name", & a "misc. information" line. The names of these files are "CO-NAME.00", "DEV-NAME.00", & "MISCINFO.00" respectively.

All files MUST be in ASCII format (i.e. only normal letters, numbers, & punctuation marks). They may be produced using any word-processor with ASCII capability or by the "copy con: <filename>" MS-DOS method.

The format of the "header' printout is as follows:

```
[company name]          [device name]

[misc. information line]

[current date]
```

The last item, current date, is automatically printed by the program.

The crt "menu-display" includes the "company name" & the "device name" as shown below:

```
FLEXION AP-1 CRYOTEST STATION          (device name)

(company name)                                    MENU NAME
```

The length of the contents of the "CO-NAME.00" & "DEV-NAME.00" file MUST NOT be greater that 38 characters. The length of the "MISCINFO.00" file contents MUST NOT be greater than 79 characters. If more characters than allowed are entered into these files, the software will "clip" the contents & use only what it allows as a maximum length. If no characters are entered into any of these files, the software will print a "blank" (i.e. nothing) in the place where the characters would normally have been printed.

The "company name" & "device name" files contain the appropriate contents when the system is shipped. The "misc. information line" file is typically set to a row of "=" (equql signs) when shipped.

INITIAL SET-UP PROCEDURE FOR THE HP150II COMPUTER

This procedure outlines those steps required to set up the HP150 before its use with the AP-1 Cryotest Station.

Before the steps in this procedure are performed, one must obtain the Hewlett Packard "system" disc that is supplied with each HP150 computer. This disc has a number of utility programs that are used in the set-up of the HP150.

One must also obtain the CY525 three-axis motor-control printed circuit board and install it in the internal card cage of the HP150. Note, this board is installed prior to shipment of the AP-1 system.

This procedure assumes that the HP150 computer has been previously assembled and connected together in the proper manner per the descriptions contained in the Hewlett-Packard manuals that come with the computer.

There are three special procedures that must be performed prior to the use of the HP150 in the AP-1 Cryotest Station. These procedures have their own description and may be performed in any order. The names of these procedures are listed below:

1. "Procedure for Setting Up the HP150 and the RAM Disc"
2. "Procedure for Setting Up the HP150 for Communication with a Host Computer"
3. "Procedure for Setting Up the HP150 and the Hewlett-Packard ThinkJet Printer"

After the above procedures are performed, the power to the HP150 should be removed. In addition, the power to the system and to the temperature controllers should be off.

The HP150 computer should now be connected to the system by installing the appropriate cable to the connector on the CY525 board.

The HP150 should also be connected, via the HPIB bus, to the two temperature controllers. The "HPIB address" of the two controllers MUST be set to "12" and "13". Use the "Temperature Controller Switch Setup Summary" document to set all switches.

The ThinkJet printer should have previously been connected to the HP150 per the appropriate procedure indicated above.

The AP-1 program is designed to interface with the operator using the touch feature of the HP150 only. It is NOT designed to use the keyboard. As such, there is no protection built into the software to handle operator keystrokes if the keyboard is attached !

INITIAL SET-UP PROCEDURE FOR THE HP150II COMPUTER (con't.)

In summary, THE KEYBOARD MUST NOT BE ATTACHED TO THE COMPUTER WHILE THE SYSTEM IS BEING CONTROLLED BY THE HP150 COMPUTER.

If the system is ready, the power to the system should now be turned on. The temperature controller power switch should then be set to the "on" position.

The "program" disc supplied by Flexion for the model AP-1 Cryotest Station system should now be installed in the left hand disc drive location.

THE "PROGRAM" DISC SHOULD NOT BE REMOVED WHILE THE AP-1 SYSTEM IS OPERATING!

The "program" for the system is supplied on two identical discs. One of these discs is labeled as a "work" disc, while the other is labeled as a "master". It is intended that the "master disc" be stored in the proper environment for disc storage and be used ONLY when the work disc is replaced.

IT SHOULD BE UNDERSTOOD THAT THE "WORK DISC" MUST BE INSPECTED PERIODICALLY AND REPLACED IF THERE ARE ANY SIGNS OF WEAR ON THE DISC SURFACE.

To produce a new "work" disk, a fresh disc must first be "formatted". To do this, install the HP "system" disc in drive A, a new disc in drive B:, and from PAM, select the "Format" application. Format the disc WITHOUT the system being copied to it. The procedure to 'format' a new disc is covered in the Hewlett-Packard manual.

Select the "MS-DOS" application from PAM. Install the "master" AP-1 'program disc' into drive A: and the new blank, but formatted, "work" disc into drive B: Then, all files on the "master" disc (in drive A:) are copied to the new "work" disc (in drive B:) by typing the MS-DOS command COPY A:*.* B: The "invisible" system files and 'MS-DOS' are then copied over by typing the command SYS B:/M

Return the "master" disc to its original storage location.

With the "work disc" installed in the left hand disc drive, and with the power ON to ALL other system components, the power to the HP150 may be turned on.

WARNING: THE AP-1 PROGRAM SHOULD ALWAYS BE STARTED "COLD" - THAT IS, WITH THE PROGRAM DISK IN DRIVE A AND THE HP150 POWER OFF.

The HP150 will now automatically execute the "boot-up" program contained on the installed disc. The action that now follows is described in the document entitled "Set-Up Program Description".

----------END----------

PROCEDURE FOR SETTING-UP THE HP150II FOR COMMUNICATION WITH A HOST COMPUTER

1. Connect a serial cable between the host and port 2 on the HP150. Important: The required cable connections are a function of the handshake method. Cable connections are discussed later in this document.

2. Install the Hewlett-Packard "system" disk into drive 0 (left hand drive).

3. Turn on the power to the HP150, or press the <SHIFT> and <CTRL> and <RESET> keys together, to obtain "PAM" with its' various application choices.

4. Start the "Easy Configuration" application by touching the appropriate key, followed by the <START APPLIC> key.

5. Once in "Easy Configuration", touch the picture of the "Secondary Host Computer (COM2)", followed by the <NEXT STEP> key.

6. Touch the picture of "Data Comm (Port 2)", followed by the <MAIN SCREEN> key.

7. Touch the <EXIT CONFIG> key to leave the application and go back to "PAM".

8. The assignment of the host connection to the HP150's serial port 2 has now been completed.

9. The serial parameters for the HP150's serial port must now be set.

10. While still in the "main menu" of "PAM", touch the <TERMINAL> key at the bottom of the crt screen.

11. Touch the "real" key labeled "USER/SYSTEM", which is located at the top center position of the keyboard.

12. Touch the <CONFIG KEYS> key on the crt screen.

PROCEDURE FOR SETTING UP THE HP150II COMPUTER FOR COMMUNICATION WITH A HOST

13. Touch the <PORT 2 CONFIG> key on the crt screen to obtain a menu of the RS232C parameters for the "Full Duplex Hardwired Port 2". An example of this display is shown below.

"XON/XOFF" HANDSHAKE EXAMPLE

```
                        FULL DUPLEX HARDWIRED     Port 2

BaudRate 9600   Parity  None   DataBits 8                      Clock INT
Asterisk Off                   Stop Bits 1          EngAck  Yes
  TR(CD) Hi   Check Parity No    SR(CH) Lo

RecvPace  XON\XOFF          SRRXmit No     RR(CF)Recv  No
XmitPace  XON\XOFF        SRRInvert No     CS(CB)Xmit  No   DM(CC)Xmit No
```

14. For systems with "xon/xoff" handshake, change the values of the various parameters so they correspond to those contained in the display above. Values are changed by touching the [TAB] key until the flashing cursor is at the parameter desired. The <NEXT CHOICE> key is then touched until the desired value is displayed.

15. For systems with "hardware" handshake, change the values of the various parameters so they correspond to those contained in the display above, with the exception of the parameters shown below:

"HARDWARE" HANDSHAKE EXAMPLE (see note 1)

```
Recv Pace   None
Xmit Pace   None                        CS(CB)Xmit  Yes    DM (CC)Xmit Yes
```

16. **After all parameters have been changed, the <SAVE CONFIG> key MUST be touched - else all changed parameters will have no effect.**

17. Touch the [SHIFT] and [STOP] keys together to return to the "PAM" display.

18. At this point the HP150II port 2 parameters have been configured.

19. The configuration parameter values are maintained during power-off conditions since they are stored in a special battery-backed RAM memory.

20. Set all communication parameters on the host identical to those on the HP150.

PROCEDURE FOR SETTING UP THE HP150II COMPUTER FOR COMMUNICATION WITH A HOST

21. XON/XOFF HANDSHAKE - CABLE REQUIREMENTS

For systems using the "xon/xoff" handshake method, the cable connections are minimal. Typically, when the "xon/off" handshake method is used, there is no need for any of the typical hardware handshake lines, that is "carrier detect", "cts", "rts", "dtr", & "dsr". These lines may be left open. The required minimum connections for the "xon/xoff" handshake method are shown below:

HOST (9 pin)	HOST (25 pin)	HP150 NAMES	HP150
-	Pin # 1	Protective Ground	Pin # 1
Pin #3	Pin # 2	Received Data (RD)	>Pin # 3
Pin #2	Pin # 3	Transmitted Data (TxD)	Pin # 2
Pin #5	Pin # 7	Signal Ground	Pin # 7

The host may still require some hardware handshake - even with xon/xoff handshake! If the above cable connections do not work for the host, try connecting the host's "DTR" back to its "DSR", "CD", and/or "CTS" (see below).

22. HARDWARE HANDSHAKE - CABLE REQUIREMENTS (see note 1)

For systems using the "hardware" handshake methods, the required cable connections are shown below:

HOST (9 pin)	HOST NAME	HOST (25 pin)	HP150 Names	HP150
-	-	Pin # 1	Protective Ground	Pin # 1
Pin #3	(TxD)	Pin # 2	Received Data (RD)	>Pin # 3
Pin #2	(RD)	Pin # 3	Transmitted Data (TxD)	Pin # 2
Pin #7	(RTS)	Pin # 4	Clear to Send (CTS)	>Pin # 5
Pin #8	(CTS)	Pin # 5	Request to send (RTS)	Pin # 4
Pin #1	(CD)	Pin # 8	x-----(No Connection) (CD)-----x	Pin # 8
Pin #6	(DSR)	Pin # 6	"Data Terminal Ready" (DTR)	Pin # 20
Pin #4	(DTR)	Pin # 20	"Data Set Ready" (DSR)	>Pin # 6
Pin #5	(GND)	Pin # 7	Signal Ground	Pin # 7

The implication of the connection diagram above is that the HP150 requires that both "data set ready" and "clear to send" are true (active high, +12v) before data will be transmitted from the HP150. The HP150 has been setup so that it does NOT need pin #8, "carrier detect"(CD), for either transmitting or receiving data. IF the host requires a signal on its carrier detect, the HP150 "DTR" signal (pin #20) should be connected to the host "carrier detect" input.

PROCEDURE FOR SETTING UP THE HP150II COMPUTER FOR COMMUNICATION WITH A HOST

HOST COMMUNICATION and 'HARDWARE-HANDSHAKE' LOCK-UP

When the HP150 host communication program sends characters to the host, and if a 'hardware-handshake' method is used to control communication, the HP150 computer hardware itself will automatically wait for the appropriate hardware handshake signal(s) from the host before returning control to the software. The hardware DOES NOT 'time-out' if the handshake signals do not occur !

When host communication is first activated, characters are sent to the host which in effect request activation of the remote mode. Therefore, the AP-1 program will "hang-up" when the host communication program is first activated if the cable connecting the host to the HP150 has not been previously connected - or if the required handshake lines do not respond to the HP150.

Failing to 'time-out' and return control to the software program upon a lack of the required hardware handshake signal(s) is an inherent design deficiency in the HP150II computer itself - and cannot be fixed ! Therefore, care must be taken when employing the 'hardware-handshake' method to assure that the required handshake signal lines are connected.

If a potential "hang-up" is not acceptable, then the XON/XOFF handshake method should be employed - assuming that this type of handshake is available in the host. With the XON/XOFF handshake, the HP150 computer continues to send characters to the host until the XOFF signal is received from the host. Therefore, if there is no connection to the host, no XOFF signal can be received - and no lock-up is possible.

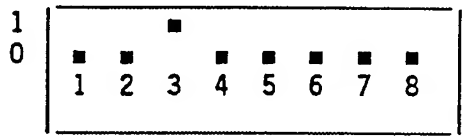
note 1: IBM compatible computers typically use a 'hardware' handshake method. If in doubt, use this method.

PROCEDURE FOR SETTING-UP THE HP150II COMPUTER & THE HEWLETT-PACKARD THINKJET PRINTER

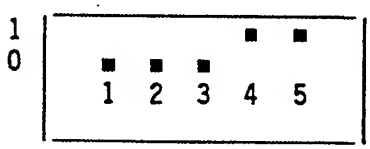
1. Connect a serial cable between the printer and port 1 on the HP150. Important: The proper cable MUST be obtained from Hewlett-Packard. The specification of this cable is "RS232C cable, male/male, p/n 13242G".

2. Set all switches on the rear of printer to the "0" position, i.e. "down", with the exception of the "mode" switch #3 which should be "up" and the RS232 switches #4 and #5 which also should be up. These positions set the printer parameters as follows: 1200 baud, 8 data bits, no parity, XON/XOFF handshake, and "perforation skip".

MODE SWITCHES



RS232 SWITCHES



3. Install the HP "system" disk into drive 0 (left hand drive).

4. Turn on the power to the HP150, or press the <SHIFT> and <CTRL> and <RESET> keys together, to obtain "PAM" with its' various application choices.

5. Start the "Easy Configuration" application by touching the appropriate key, followed by the <START APPLIC> key.

6. Once in "Easy Configuration", touch the picture of the "primary printer", followed by the <NEXT STEP> key.

7. Touch the picture of the ThinkJet printer, followed by the <NEXT STEP> key.

8. Touch the picture of "data comm (port 1)", followed by the <MAIN SCREEN> key.

9. Touch the <EXIT CONFIG> key to leave the application and go back to "PAM".

10. The assignment of the ThinkJet printer to the HP150's serial port 1 has now been completed.

11. The serial parameters for the HP150's serial port must now be set to match those of the ThinkJet printer.

12. While still in the "main menu" of "PAM", touch the <TERMINAL> key at the bottom of the crt screen.

PROCEDURE FOR SETTING UP THE HP150II COMPUTER & THE THINKJET PRINTER

13. Touch the "real" key labeled "USER/SYSTEM", which is located at the top center position of the keyboard.

14. Touch the <CONFIG KEYS> key on the crt screen.

15. Touch the <PORT 1 CONFIG> key on the crt screen to obtain a menu of the RS232C parameters for the "full duplex hardwired port 1". An example of this display is shown below.

```
                        FULL DUPLEX HARDWIRED     Port 1

BaudRate 1200    Parity  None    DataBits 8
Asterisk Off                     Stop Bits 1                    Clock INT
  TR(CD) Hi    Check Parity No     SR(CH) Lo          EngAck  Yes

RecvPace  None                      SRRXmit No     RR(CF)Recv  No
XmitPace  None                    SRRInvert No     CS(CB)Xmit  No  DM(CC)Xmit No
```

16. Change the values of the various parameters (shown in bold) so they correspond to those contained in the display above. Values are changed by touching the [TAB] key until the flashing cursor is at the parameter desired. The <NEXT CHOICE> key is then touched until the desired value is displayed.

IT MUST BE POINTED OUT THAT THERE IS NO HANDSHAKE ENABLED, AS FAR AS THE HP150 IS CONCERNED, BETWEEN THE PRINTER AND THE HP150. THIS IS DONE TO PROHIBIT THE PRINTER, IF OUT OF PAPER, TO "HANG UP" THE OPERATION OF THE HP150.

17. CAUTION: After all parameters have been changed, the <SAVE CONFIG> key MUST be touched - else all changed parameters will have no effect.

18. Touch the [SHIFT] and [STOP] keys together to return to the "PAM" display.

19. At this point the HP150II and the ThinkJet printer have been configured.

20. The configuration parameter values are maintained during power-off conditions since they are stored in a special battery-backed RAM memory.

----------END----------

PROCEDURE FOR SETTING UP THE HP150II COMPUTER'S "RAM DISK"

1. Install the Hewlett-Packard "system" disk into drive "A" (left hand drive).

2. Turn on the power to the HP150, or press the <SHIFT> key and <CTRL> and <RESET> keys together, to obtain "PAM" with its' various application choices.

3. Start the "Device Configuration" application by touching the appropriate key, followed by the <START APPLIC> key.

4. Once in "Device Configuration", touch the [TAB] key until the enhanced box is next to disk drive C: . At this point, touch the <NEXT CHOICE> key at the bottom of the crt screen until the choice displayed is "RAM DISC".

5. Continue to touch the [TAB] key until the enhanced box is next to the area lableled "RAM DISC SIZE". At this point touch the <NEXT CHOICE> until a choice of 360 K bytes is displayed.

6. Touch the <SAVE CONFIG> key at the bottom of the crt to save the displayed device configuration into battery-backed RAM memory.

7. Touch the <EXIT CONFIG> to return to "PAM".

8. Disc drive "C", with a size of 360K bytes, is now assigned to RAM memory. This assignment will be maintained during power-off conditions.

9. It is necessary that the Hewlett-Packard 384 K RAM memory card be installed in SLOT #1. The AP-1 Cryotest program will not run without this card.

----------END----------

SET-UP PROGRAM DESCRIPTION

AUTO START-UP:

When the HP150 powers up, the first software routine that runs is the "AUTOEXEC.BAT" program. This is technically a "batch-file". It transfers all required files to the "drive C" RAM disc. After all required software has been transferred to the RAM disc, the "setup" program is loaded and run.

"QUICK EXECUTION"

A special feature of the "setup" program allows the operator to choose at the start of the "setup" program (by means of a crt touch key) whether a full start-up procedure should be executed or whether a quick (i.e. shortened) execution of the program should be performed. The default condition (i.e. if the operator does not touch the crt key within 10 seconds) is for a "quick execution". During "quick execution", the full complement of tests and printouts (if separately enabled) are not performed. These printouts include lists of all software flags, setpoint values, and map coordinates, etc.

SOFTWARE-FLAGS FILE:

The "setup" program obtains the "user-programmable" software-flags "SW-FLAGS.00" file from drive A. These flags are used to configure the software. The settings of all software flags are printed at the beginning of the 'setup' program, as long as the "quick-execution" feature is not enabled. An example of this printout, with default flag settings, is shown below:

(company name) (device name)

(misc. info line)

'SETUP' PROGRAM: SETUP62G.BAS date: 11/17/87

FLAG SETTING SUMMARY:

'PRINT.SP' = 1
(0=disable, 1=print sp values)

'PRINT.MAP' = 1
(0=disable, 1=printout current map data)

'PRT.OUT' = 1
(1=enable printouts, 0=disable further printouts)

'TEMP.PRT' = 1
(0=disable, 1=enable temp vs. time printout during cooling & heating)

(Print-out continues on next page)

SOFTWARE-FLAGS FILE: (cont.)

TEMP. CTRL MODEL # = 1
(0 = DRC-81C, 1 = MODEL 805)

'SENSOR A ID' (TC #1) = 90
'SENSOR A ID' (TC #2) = 70
'SENSOR B ID' (TC #1) = 40
'SENSOR A ID' (TC #2) = 40
(00= curve 'DRC-D', 10= curve 'DRC-E1', 20= curve 'CRV-10', 30= curve 'DIN-Pt')
(40= ext. 'CRV-10')

'JUST.TOUCH' = 0
(0=disable, 1=enable 'just-touching' input)

"PERIMETER PADS" = 0
(1 = Perimeter pads configuration, 0 = normal)

'AUTO-GOTO-TEST'= 1
(1-auto goto test pos after xy home; 0-no auto goto test pos)

'RANDOM-ARRAY-MAP'= 0
(1-random array map, i.e. 'fixed', 0-normal programmable map)

'RANDOM-DIE-MAP'= 0
(1=random xy map, i.e. 'fixed', 0=normal programmable map)

'TEST/DIE' = 1
(1='test' label, 0='die'/'array' label)

'Z.MAP' = 0
(0=disable, 1=enable height map, z-axis)

note 2: For some systems, the 'die, array position' designation is not appropriate. In these cases, the general 'test position' designation may be used. The 'test position' designation is used when there are NO 'arrays' (i.e. 'sub-positions') within each die AND the various map positions on the wafer are more appropriately called 'test positions'. To enable the "test position" label, the "test/die" software-flag is set to "1".

SET-UP PROGRAM DESCRIPTION (con't.)

SETPOINT FILE:

The "setup" program obtains the current temperature controller setpoint values, the probe limits, and the map configuration parameters from the "SP.01" file in drive A. These values are printed out during execution of the "set-up" program if the "PRINT.SP" flag is set to 1 in the "software flags" file and the 'quick-exec' function is not activated. An example of this printout is shown below (see note 2) :

Since the setpoint values can be entered directly into the "setpoint" file, the software checks that each entry is within an acceptable range when the "setup" program executes. Warning: the software does not check that all "software flags" and "setpoint" values are compatible!

All setpoints must be within an acceptable range for the program to continue. If not, the program is terminated.

CURRENT SETPOINT VALUES:

TEMP. CONTROLLER #1 'CONTROL' SETPOINT:	120
TEMP. CONTROLLER #1 'PROPORTIONAL' SETPOINT:	50
TEMP. CONTROLLER #1 'INTEGRAL' SETPOINT:	51
TEMP. CONTROLLER #1 'RANGE, COOL' SETPOINT:	3
TEMP. CONTROLLER #1 'RANGE, HEAT' SETPOINT:	3
TEMP. CONTROLLER #2 'CONTROL' SETPOINT:	120
TEMP. CONTROLLER #2 'PROPORTIONAL' SETPOINT:	50
TEMP. CONTROLLER #2 'INTEGRAL' SETPOINT:	51
TEMP. CONTROLLER #2 'RANGE, COOL' SETPOINT:	3
TEMP. CONTROLLER #2 'RANGE, HEAT' SETPOINT:	3
'SECRET' CODE FOR SETPOINT ENTRY	860
DISTANCE BETWEEN DIE POSITIONS, X-AXIS	5218
DISTANCE BETWEEN DIE POSITIONS, Y-AXIS	1750
NUMBER OF DIE POSITIONS, X-AXIS	5
NUMBER OF DIE POSITIONS, Y-AXIS	5
DISTANCE BETWEEN ARRAYS, X-AXIS	68.6
NUMBER OF ARRAYS PER DIE POSITION	10
PROBE 'MIN.-CLEAR' POSITION	240
PROBE 'CLOSE' POSITION	500
PROBE 'MAX.-DOWN' POSITION	2000

SET-UP PROGRAM DESCRIPTION (con't.)

MAP FILES

If there are no "user-programmed" "random" maps, the "setup" program calculates the specific coordinate values for all map positions using the map configuration parameter values. These map coordinate values are then saved to "C" drive (RAM disc) for use by the various menu programs. The coordinate values are printed out during the "set-up" program if the "PRINT.MAP" flag is set to 1 and the 'quick-exec' feature is not enabled. If "random" maps are enabled, the appropriate map coordinate files are transferred to the "C" drive from drive A.

An example of this printout is shown below. It is based upon the map configuration parameter values shown in the example above. (see note 2)

DIE COORDINATE MAP: X-POSITION, Y-POSITION

DIE MAP ID #1: 5218 DIE MAP ID #2: 1750

DIE # 1 : 0 , 0
DIE # 2 : 5218 , 0
DIE # 3 : 10436 , 0
DIE # 4 : 15656 , 0
DIE # 5 : 20872 , 0
DIE # 6 : 0 , 1750
DIE # 7 : 5218 , 1750
DIE # 8 : 10436 , 1750
DIE # 9 : 15656 , 1750
DIE # 10 : 20872 , 1750
DIE # 11 : 0 , 3500
DIE # 12 : 5218 , 3500
DIE # 13 : 10436 , 3500
DIE # 14 : 15656 , 3500
DIE # 15 : 20872 , 3500
DIE # 16 : 0 , 5250
DIE # 17 : 5218 , 5250
DIE # 18 : 10436 , 5250
DIE # 19 : 15656 , 5250
DIE # 20 : 20872 , 5250
DIE # 21 : 0 , 8750
DIE # 22 : 5218 , 8750
DIE # 23 : 10436 , 8750
DIE # 24 : 15656 , 8750
DIE # 25: 20872 , 8750

ARRAY COORDINATE MAP:

ARRAY MAP ID #: 68.6

ARRAY POS. # 1 : 0
ARRAY POS. # 2 : 69
ARRAY POS. # 3 : 137
ARRAY POS. # 4 : 206
ARRAY POS. # 5 : 274
ARRAY POS. # 6 : 343
ARRAY POS. # 7 : 412
ARRAY POS. # 8 : 480
ARRAY POS. # 9 : 549
ARRAY POS. # 10 : 617

SET-UP PROGRAM DESCRIPTION (con't.)

Z-MAP TRANSFER:

If the "z-map" is enabled, the appropriate file with the probe offset values is transferred to the "C" drive from drive A. The AP-1 system may be used to probe a wafer which has 'dies' that are at different elevations (see note 3). In this case, the values for the z-offset map must be HAND-ENTERED into the "ZDIEMAP.00" file and 'enabled' by setting the 'Z-MAP' flag = 1.

Systems that have a 'z-axis offset' map have by necessity a FIXED die, array map configuration. That is, the number of dies in the x & y directions is fixed & cannot be changed in the setpoint menu. The step distance between dies, and between arrays may still be changed however.

CAUTION: THERE MUST BE A SEPARATE DISC FOR EACH Z-MAP CONFIGURATION. CARE MUST BE TAKEN TO USE THE APPROPRIATE DISC OR DAMAGE TO THE WAFER WILL CERTAINLY RESULT !

An example of the printout for the Z-Map is shown below. This map is only printed if the 'z.map' flag is set to 1 (which enables the z-map effect) and the 'quick-exec' feature is not activated.

Z-AXIS OFFSET COORDINATE MAP (steps BELOW 'zero' position)

Z-MAP ID # : 021287

TEST POSITION # :	OFFSET (# steps)
1	5
2	20
3	35
.	.
.	.
.	.
23	15
24	20
25	10

note 3: Wafers that have 'arrays' (i.e. 'sub-positions' within each die) MUST have all 'arrays' within each die at the SAME elevation.

HPIB BUS CHECK-OUT:

The HPIB interface is checked during set-up program execution, with respect to its capability to allow communication between the two temperature controllers and the HP150 computer. These components should be connected prior to the initiation of the "set-up" program.

The results of the HPIB interface test are printed out if the software PRT.OUT flag is set to 1. The printout will indicate exactly which test failed and the nature of the failure. In addition, data indicating which options are installed in the temperature controllers will be printed out. An example is shown below:

FAILURE EXAMPLE:

```
HBIB BUS SETUP & CHECK-OUT

TIME-OUT ERROR:  CANNOT SET DISPLAY = SENSOR B ON TEMP. CONTROLLER #1
TIME-OUT ERROR:  CANNOT SET DISPLAY = SENSOR B ON TEMP. CONTROLLER #2
TIME-OUT ERROR:  CANNOT send string to temp control #1
TIME-OUT ERROR:  CANNOT get data from temp control #1

TIME-OUT ERROR:  CANNOT send string to temp control #2
TIME-OUT ERROR:  CANNOT get data from temp control #2

Temp control #1 IEEE-488 BUS operation is FAULTY !
Temp control #2 IEEE-488 BUS operation is FAULTY !
```

PASSED EXAMPLE:

```
HPIB BUS SETUP & CHECK-OUT
A - D3 , B - D3 , 1 - EMPT , 2 - 8054
A - D3 , B - D3 , 1 - EMPT , 2 - 8054
OK
```

The information printed-out in the 'passed' example above indicates the sensor type for sensor A and B. It also indicates the model # of the boards installed in option slots 1 and 2. Note, option # 8054 indicates the HPIB, IEEE-488 bus interface board.

CY525 MOTOR CONTROL BOARD:

The CY525 three-axis motor control board, which is installed in the HP150, is initialized and tested during the execution of the set-up program. This test initializes the three cpu's on the board and sets the motor-control parameters for the three axes to their initial values. The values of all control parameters are "read back" to verify that the values have been properly set.

Special "control programs" are also down-loaded to the cpu's. These control programs are also read back to verify the correctness of the down-load process.

The result of all initialization and testing of the motor-control board is printed out if the software "PRT.OUT%" flag is set to 1 and the 'quick-exec' function is not enabled. A printout example is shown below.

If the initialization and test of the CY525 board fails, all actual motion in the in the x, y, or z-axis directions is inhibited - although entry to the various menus associated with motion is still allowed.

CY525 SETUP & CHECK-OUT

```
RESET CT525's SET INITIAL VALUES IN CONTROL REGISTERS F1, F2, F3
& OUTPUT REGISTERS F4, F5, F6
  3  11  96
  3  11  0
  3  11  0
INITIALIZE CY525 CHIP # 1:OK
INITIALIZE CY525 CHIP # 2:OK
INITIALIZE CY525 CHIP # 3:OK
SET PROGRAMMABLE BIT = HIGH, CHIP # 1:OK
SET PROGRAMMABLE BIT = HIGH, CHIP # 2:OK
SET PROGRAMMABLE BIT = HIGH, CHIP # 3:OK
IF 3:s 255:Z 1:N 1:R 3:
SET DEFAULT PARAMETERS IN CHIP # 1 :OK
2F 3:S 255:Z 1:N 1:R 3:
SET DEFAULT PARAMETERS IN CHIP # 2:OK
4F 3:S 255:Z 1:N 1:R 3:
SET DEFAULT PARAMETERS IN CHIP # 3:OK
GET DEFAULT PARAMETERS IN CHIP # 1:OK
GET DEFAULT PARAMETERS IN CHIP # 2:OK
GET DEFAULT PARAMETERS IN CHIP # 3:OK
VERIFY DEFAULT PARAMETERS IN CHIP # 1:OK
VERIFY DEFAULT PARAMETERS IN CHIP # 2:OK
VERIFY DEFAULT PARAMETERS IN CHIP # 3:OK
VERIFY STATUS REGISTER INITIAL VALUE, PORT #FA:OK
F hex
VERIFY STATUS REGISTER INITIAL VALUE, PORT #FB:OK
F hex
VERIFY STATUS REGISTER INITIAL VALUE, PORT #FC:OK
F hex
LOAD CY525 PROGRAM INTO CHIP #  1:OK
LOAD CY525 PROGRAM INTO CHIP #  2:OK
LOAD CY525 PROGRAM INTO CHIP #  3:OK
READ PROGRAM BUFFER IN CHIP #  1:OK
READ PROGRAM BUFFER IN CHIP #  2:OK
READ PROGRAM BUFFER IN CHIP #  3:OK
SET MOTOR PHASES, & 'PROG. BIT' = LOW, CHIP # 1:OK
SET MOTOR PHASES, & 'PROG. BIT' = LOW, CHIP # 2:OK
SET MOTOR PHASES, & 'PROG. BIT' = LOW, CHIP # 3:OK
```

2

Plts / Defts EXHIBIT 583
for Identification
Witness H. Applebay
Dated 5/13/98
Page 56 of 187 Pages
By Dolores Calderin CSR #9746

2

Plaintiff's / Defendant's EXHIBIT 583
for Identification
Witness A. Applebay
Dated 5/13/98
Page 55 of 187 Pages
By Dolores Calderin CSR #9740

DESCRIPTION: MAIN MENU & COVER CONTROL

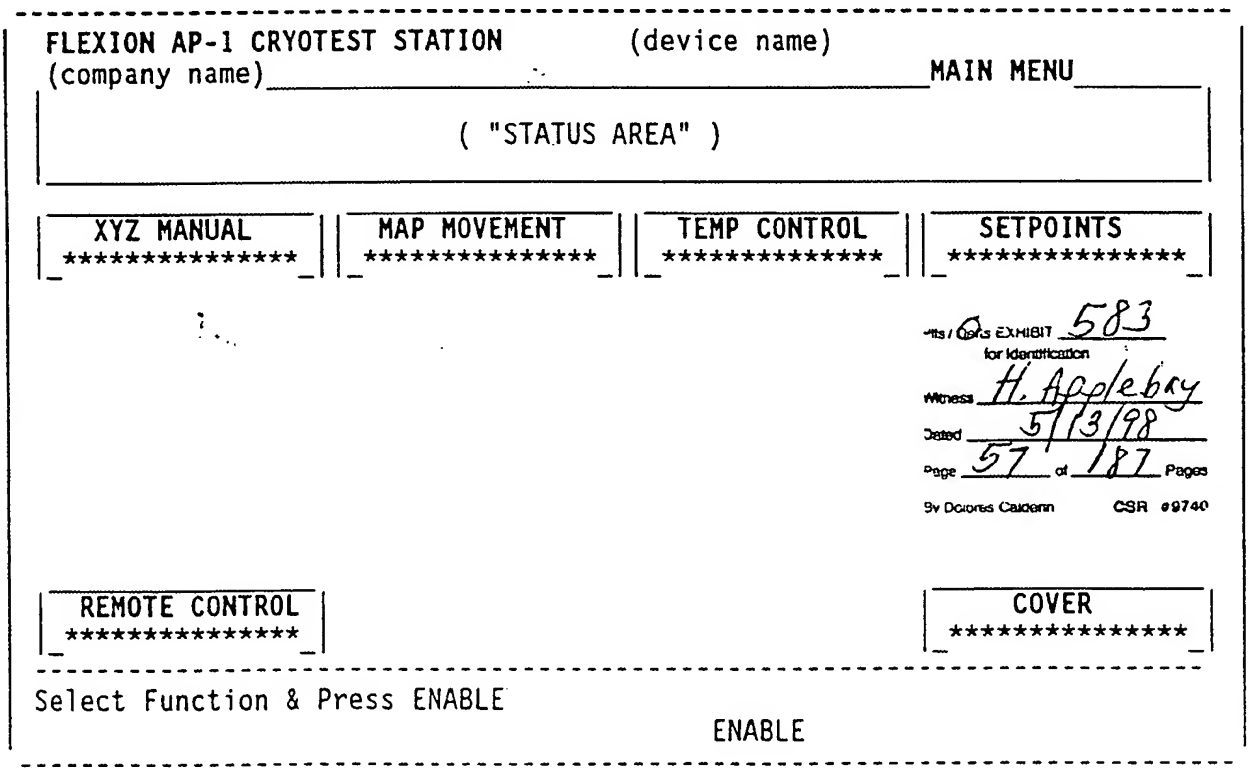
MAIN MENU

On the main menu there are a number of function choices, each choice corresponding to a major "mode" of operation.

To select a particular function, it must first be touched (i.e. "selected"), and then "activated" by touching the <ENABLE> key. This "two-step" selection process prevents accidental activation of a function; and is especially useful when an operator is directly controlling the system from the HP150 touchscreen.

If a function has been mistakenly selected, then another may be chosen by touching a different function key. It is only after the <ENABLE> key has been touched that a function is "activated".

In general, each function on the main menu (except the "cover" function) has associated with it a section of software which is automatically downloaded from the "RAM-disk" at the time the function is activated.



DESCRIPTION: MAIN MENU & COVER CONTROL (continued)

As can be seen in the above figure, there are five menus that are used to control the operation of the system. The "REMOTE CONTROL" menu is used to initiate communication with the host computer. The "SETPOINTS" menu is used to download parameters into the two temperature controllers and to change the maps. The "TEMPERATURE CONTROL" menu is used to cool down and warm up the probe and wafer assembly via the temperature controllers. The "MAP MOVEMENT" menu is used to increment the wafer to distinct "die" and "array" positions. The "XYZ MANUAL" menu is used to manually step and/or slew the probe and wafer assemblies, to "set" the various probe and wafer positions, and to adjust the theta position of the wafer.

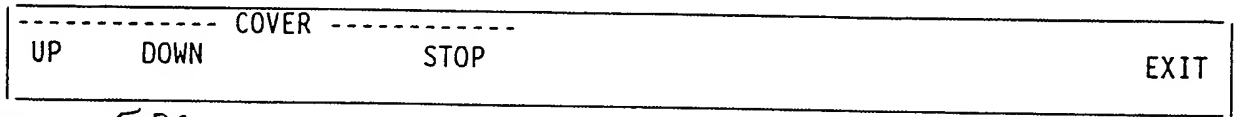
COVER MOVEMENT

While in the main menu, the cover may be moved to the "up" position or to the "closed" position. It is only when the main menu is displayed that the cover may be moved.

To activate cover movement, the <COVER> key must be touched followed by the <ENABLE> key. After touching the <ENABLE> key, three action choices are displayed (see figure below). These are "up", " down", and "stop". Movement in the desired direction is accomplished by simply touching the <UP> or <DOWN> key. Any movement once initiated, may be terminated immediately by touching the <STOP> key. When the cover obtains the desired position, i.e. " fully up " or "down and sealed", the position is indicated by emphasizing the appropriate UP or DOWN key label. If the movement is stopped before the cover moves to either of its end positions, neither of the key labels is emphasized.

If the time for movement to either of the end positions exceeds a preset "timeout" value, the operator is informed of this condition by a message in the "status" area at the top of the menu display and the cover movement is automatically terminated.

Cover movement is inhibited if the "wafer access lid" assembly is up, if the probe assembly is not in the up or "home" position, if the wafer is not in its centered or "home" position, or if the system is not at atmosphere.



XYZ MANUAL MOVEMENT MENU DESCRIPTION (see note 1)

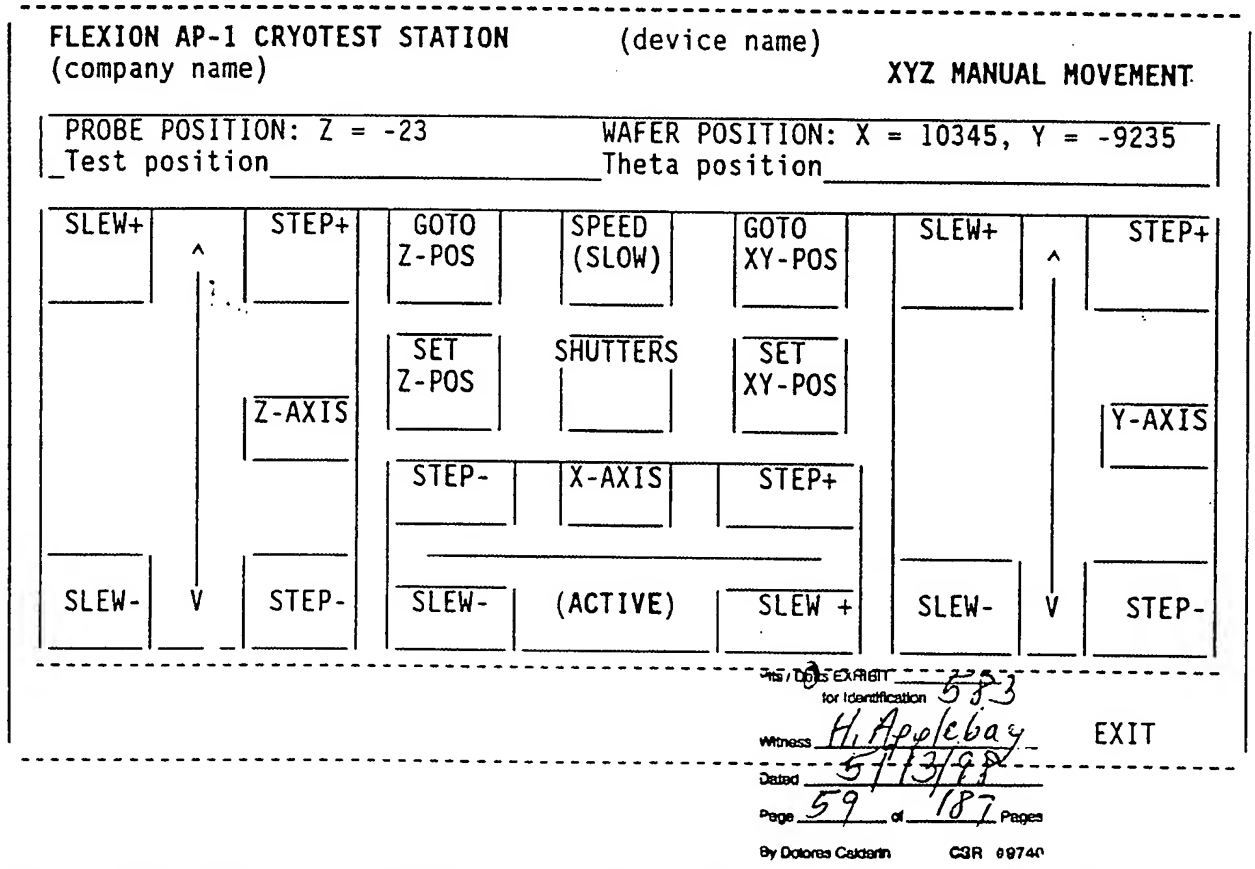
This menu is obtained by touching the <XYZ MANUAL> key on the main menu display.

As can be seen by examining the figure that follows, this menu is used to step and/or slew the wafer and probe assemblies. The wafer and probe assemblies may also be moved to distinct predefined positions with this menu. These positions are "set" using various functions available in this menu. Additionally, the "top", "view", and "side" shutters can be controlled with this menu.

Only one axis at a time is activated for stepping or slewing. The "active" axis is indicated by the word "active" being enhanced within the X,Y, or Z box. To activate a different axis, touch the appropriate axis name.

The absolute positions of the wafer and probe assemblies, with respect to their "home" positions, are shown in the "status-box". The "name" of the wafer and probe position is also shown if applicable.

Upon entry to this menu from another menu, or upon HP150 power-up, the probes will automatically go to their fully-up or "home" position.



DESCRIPTION: XYZ MANUAL MOVE (continued)

STEPPING AND SLEWING (see note 1)

To cause an incremental step movement, the <STEP+> or <STEP-> key is touched. If one continues to touch the step key, repetitive steps will occur.

To initiate a continuous and smooth movement, the <SLEW +> or <SLEW-> is touched. The slew movement will stop when ones' finger is taken off the key.

In general, movement of the wafer assembly in the x or y direction is inhibited if the probe assembly is not more than the "minimum-clear" number of steps from the "zero" position or if the "zero" position has not been "set". However, x or y movement is allowed if the probe assembly is at its "home" or "fully-up" position, regardless of whether the "zero" position has been set.

If the z-map is enabled, the probe position must be greater than 'minimum clear + 'z-max' for xy movement to be enabled. Where the 'z-max' value is equal to the maximum elevation difference across the surface of the wafer. (see "Z Map Description" document for more information relating to xyz movement when the z-map is enabled).

"Slewing" of the probe assembly in the negative direction, i.e. towards the wafer surface, is not allowed until the probe "zero" position has been "set". However, slewing in the negative direction is not allowed if the probe assembly is below the "zero" position. In addition, downward probe movement is inhibited if the system is at atmosphere.

While the wafer and/or probe assembly is moved, the associated absolute position values in the x,y, and z directions are displayed in the "status" box at the top of the menu. In addition, whenever an x,y coordinate set or a z-coordinate corresponds to a particular position such as "+ limit switch", "probe home position", or "theta position", the name of this position is displayed under the x,y, or z position values. An example of this is shown in the figure of the menu above.

The rate of stepping during "slewing" may be changed by repeatedly touching the <SPEED> key until the desired speed is indicated. There are three speeds available. These are "slow", "medium", and "fast - which correspond respectively to speeds of 10, 100, and 660 steps per second.

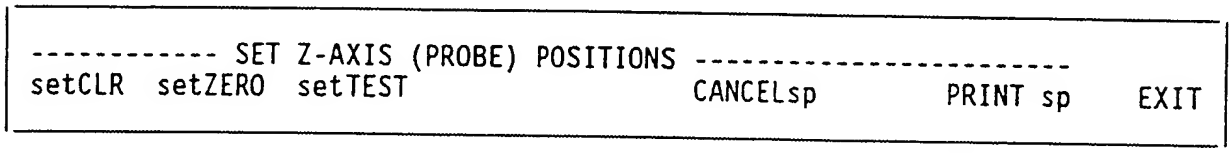
The step rate during "stepping" may be also changed using the speed key. The three speeds available correspond to 1 step/touch of the <STEP> key, 5 steps/touch, and 10 steps/touch.

note 1: This description assumes that there is no z-offset map enabled. If this is not the case, the document "Z-Map Description" MUST be read ! It descibes the 'z-map' features & the special considerations in 'setting' & 'going to' the various probe positions.

DESCRIPTION: XYZ MANUAL MOVE (continued)

SETTING THE PROBE POSITIONS (see note 1)

There are three probe positions that must be defined. These are "clear", "zero", and "test" positions. To define these positions, one must move the probe assembly to the desired position and then "set" the position by touching the <SET CLR>, <SET ZERO>, or <SET TEST> key, as appropriate (see figure below). The "zero" position MUST be set before the other two positions. All subsequent z-axis position values will be with respect to this zero position. Previous to setting the zero position, z-axis position values are with respect to the fully-up or "home" position.



To set the "zero" position, one must step the probes down to the "just touching" position and then "set" this position to "zero" by touching the <SET ZERO> key. The "zero" position cannot be set until the probes have previously been at the 'home' position.

The probes are inhibited from moving to a position farther down than that specified by the "max-down" setpoint. This setpoint is designed to prohibit the user from smashing the probes into the wafer surface. As such, great care should be taken if this setpoint is changed.

To set the "test" position, the probe assembly is stepped down below the "zero" position until the desired amount of "over-travel" is obtained - at which time the <SET TEST> key is touched. The "test position" is inhibited from being set to a value less than -50 steps.

To set the "clear" position, the probes are brought up a number of steps above the "zero" position. This position represents a level where the probes are not in danger of touching the wafer surface throughout the full travel of the wafer. The value of this "clear" position is inhibited from being set to a level less than the "minimum-clear" setpoint value ("minimum-clear" + 'z-max' if the z-map is enabled).

Once these positions are "set", the probes can go directly to these positions - through use of the "goto z-pos" function described in the next section.

For convenience, one can "cancel" all setable probe positions. This is done by touching the <CANCELsp> key. After touching the <CANCELsp> key, it is necessary to "set" the "zero", "clear", and "test" positions again.

DESCRIPTION: XYZ MANUAL MOVE (continued)

The value of the probe positions (in steps from the zero position) may be printed on an external serial printer by touching the <PRINT SP> key. If the probe positions have not been set or have been canceled, the printed value will indicate "not set".

MOVING THE PROBES (see note 1)

There are a number of predefined positions that the probe assembly may be directed to at the request of the operator. To activate probe movement to these positions, the <GOTO Z-POS.> key must be touched. The position choices are then displayed at the bottom of the screen.

```
 ------------- GOTO Z-AXIS (PROBE) POSITIONS -------------------
CLRpos  ZEROpos  TESTpos                    HOMEpos  CLOSE   TOUCH     EXIT
```

Movement to the "clear", "zero", "test" positions is initiated by touching the <CLR POS>, <ZERO POS>, and <TEST POS> keys, respectively. Movement to these positions is enabled only when the corresponding position has been "set". Setting of these positions has been explained in the previous section.

Movement to the "home" position is initiated by touching the <HOME POS> key. The "home" position of the probes corresponds to that position when the "up limit switch" is actuated. Movement to the probe 'home' position will reset the z-axis position value to zero if the probe 'zero position' has not been set.

To facilitate the setting of the "zero position", the probes may be brought down from the "home" position to a position "close" to the wafer surface. The distance down from the "home" position is set initially to 500 steps. This movement is initiated by touching the <CLOSE> key. Movement to the "close" position is inhibited if the probes are not initially in the "home" position. The 'close' position may be changed in the "setpoint" menu. Its initial or default value is set in the 'setpoint" file.

In systems in which the function is enabled, the probes may be lowered automatically until an external signal indicates that the probes are "just-touching". To enable this function, the appropriate flag must be set in the "software flags" file, and the corresponding input signal connected. The default value for this setting is "function disabled".

All downward probe movement, i.e. movement to the "clear", "zero", "test", "close", & "touch" positions, is inhibited if the system is at atmosphere - as established by the "atmosphere switch". Movement to the probe "home" position is always enabled.

DESCRIPTION: XYZ MANUAL MOVE (continued)

SETTING THE WAFER POSITIONS (see notes 1 & 2)

The position of the wafer where the probe assembly is positioned correctly over 'die # 1' must be set before movement to this position can be accomplished automatically. To "set" the "die #1" position, the wafer must be manually stepped and/or slewed in the x and y direction to the required position, at which time the <SET die #1> key is touched. To access this key, one must first touch the <SET XY-POS> key.

```
---------- SET XY-AXIS (WAFER) POSITIONS ----------
set DIE #1                          get SP      print SP   EXIT
```

One can obtain an approximate, default value for the "die #1" position by touching the <GET SP> key. In the case of "non-random" maps, this default value is based upon the current map configuration parameter values and assumes the the wafer (i.e. map) is CENTERED on the stage. In the case of "random" maps the coordinates for the "die #1 position" are obtained from the "dielpos.00" file - which has been uploaded to the RAM disc from drive A. After touching the <GET SP> key, it is no longer necessary to "set" the "DIE #1" position.

The default value for the DIE #1 position may be examined by touching the <PRINT SP> key. The coordinate values will be displayed on the crt as well as printed-out.

Obtaining the default value for the DIE #1 position is advantageous, since once the home position has been set, one can request movement to the "DIE #1" position without previously having been there.

If a newly installed wafer moves to the DIE #1 position, based on a default value, the position of the wafer will, in general, have to be re-adjusted and "set" - since the wafer will be only approxiamately at the DIE #1 position.

note 2: In some systems, the 'die' positions may be more appropriately called 'test' positions. In these cases, the 'DIE #1' labels will read "TP #1".

DESCRIPTION: XYZ MANUAL MOVE (continued)

MOVING THE WAFER (see note 2)

Movement to the "home" or "DIE #1 " positions is initiated by first touching the <GOTO XY POS> key and then the <HOME POS> or <DIE#1 pos> key.

---------- GOTO XY AXIS (WAFER) POSITIONS ----------						
HOMEpos	DIE#1pos	+ENGAGE	-ENGAGE	to THETA	1v THETA	EXIT

Movement to the "DIE #1 " position is inhibited if (1) the "DIE #1 " position has not been "set" or its value retreived using the <GET SP> key, (2) the wafer has not been previously at its "home" position, (3) the wafer is in the "theta" position , or (4) if the probes are not sufficiently above the surface of the wafer.

For the software to establish that the probes are sufficiently above the surface of the wafer, the "zero" position of the wafer must have been previously set and the actual position of the probes must be at least "minimum clear" steps above the "zero" position ("minimum clear" + 'z-max' if z-map is enabled). If the "zero" position has not been previously set, then the probes must be in their "home" or "up" position to enable wafer movement to the DIE #1 position.

Before wafer movement to the "home" position, the probe assembly is automatically moved to its "clear" position (assuming the probe "clear" position has been previously set). However, if the probes are at their "home" position at the initiation of an xy movement, they will remain there and are not brought down to the "clear" position.

Movement to the "home" position is initiated by touching the <HOME POS> key. As indicated above, the probes will automatically raise above the surface of the wafer before movement of the wafer to its home position. Movement of the wafer to its home position is accomplished in two distinct movements. First, the wafer is moved in the appropriate direction in the x-axis until the x-axis home switch is actuated. Second, the wafer is moved in the appropriate direction in the y-axis until the y-axis home switch is actuated.

There is no requirement on initial wafer position before movement to the wafer home position. Also, due to additional switches mounted on the wafer motor assemblies, the software can establish which direction it must move the wafer to obtain the "home" position. It should be noted that the "home" position is the "centered" position of the stage assembly.

DESCRIPTION: XYZ MANUAL MOVE (continued)

THETA ADJUSTMENT

The operator may adjust the theta or angular position of the stage by using the following procedure.

First, the <GOTO XY POS> touch key is selected. There are four choices relating to theta adjustment presented to the operator, i.e. <+ ENGAGE>, <-ENGAGE>, <TO THETA>, and <LV THETA>.

To adjust the angular position of the stage, the operator must first put the stage in its "theta" position. To do this the operator touches the <TO THETA> key. The stage will then go automatically to the "theta position". The theta position is the extreme left position of the x axis, with the y axis at its home position.

It should be noted that the stage MUST be in the "home position" (at least with respect to the y-axis) before a movement to the theta position is allowed.

Once the stage is in the theta position, the wafer CANNOT be effectively rotated until the theta mechanism is engaged. This is accomplished by touching either the <+ ENGAGE> or the <- ENGAGE> key. Touching one of these keys will initiate an automatic movement in the + or - y axis direction (as selected) until a micro switch mounted on the theta mechanism indicates mechanical engagement. At this point the wafer may be stepped in the y axis direction (in the SAME direction in which the mechanism was engaged) to affect a change in the rotational angle of the wafer position, i.e. the "theta" angle.

To rotate the wafer in the other direction, the opposite "engage" key must be selected. After the wafer moves to the opposite engagement point, the operator may step the wafer in the y-direction to adjust the theta angle in the other direction.

While the stage is in the "theta position" and "engaged", the total number of steps in either the + or - y axis direction is limited to a maximum of 1600. When the NET number of steps in either direction to exceeds 1600, the operator is informed and any additional steps in the associated direction is inhibited.

During "theta adjustment" the stage may be "stepped" in the y direction at three different speeds. That is, either one step per touch of the <STEP +> or <STEP -> keys, 5 steps per touch, or 10 steps per touch. The speed is set by repeatedly touching the SPEED key until the desired speed is displayed.

DESCRIPTION: XYZ MANUAL MOVE (continued)

After the stage has been rotated the appropriate amount, the stage may be brought out from the theta position by touching the <LV THETA> key. The stage will first travel in the y-axis direction to the y-axis "home position". Then it will travel in the x-axis direction from the "theta position" to the "left limit" position. This is the "normal" left-most position of the stage in the x-axis. From this point the operator may move the stage in the x-axis direction to check and/or verify that the angular position of the wafer has been adjusted properly.

STANDBY MOTOR POWER

To minimize the power dissipation of the XY motors and their drivers, the voltage to these motors is brought down to a "standby" level whenever there has been no movement in the X or Y direction for a period of 1 minute. When an X or Y movement is required, and the voltage is at the "standby" level, the voltage is brought back up to the full power level. There is a slight delay before the movement starts to allow the voltage to stabilize. Upon initial entry to the "XYZ MANUAL MOVEMENT" menu, the voltage to the motors will be at the "standby level.

DESCRIPTION: XYZ MANUAL MOVE (continued)

OPERATING THE SHUTTERS

Shutter operation is activated by touching the <SHUTTERS> key on the xyz manual movement menu. After touching this key, a set of keys corresponding to the three shutters and their various positions is displayed at the bottom of the crt screen.

If a '2-position' shutter if specified, the 'FILTER' legend will not appear - and only two positions of the top shutter will be possible. See the document "Addendum: The 'Top' and 'Side' Shutter Files" for more information on configuring the shutters.

The actual state of each shutter is indicated by the appropriate position being enhanced with a bright inverse label. An unknown shutter condition is indicated by no enhanced shutter position.

-----TOP SHUTTER------			-VIEW-	-------SIDE SHUTTER--------			
CLOSED	FILTER	OPEN	CLOSED	CLOSED	FILTER 1	FILTER 2	EXIT

To set the 'top' and 'side' shutters to a desired state, the appropriate label is touched. These two shutters have feedback inputs which indicates the true position of the shutter. These feedback inputs are checked after each shutter movement to assure that the shutters have moved to the requested position. If the feedback indicates that the shutter has not moved to the required position within a preset time, an appropriate message is displayed in the "status" box on the crt display.

The "closed" and "filter" positions of the top shutter are inhibited if the "wafer-acess lid" is not down. In addition, the top shutter is automatically reset to the 'open' position whenever the wafer access lid is raised.

The 'view' shutter is set to either 'open' or 'closed' by 'toggling' the shutter state by repeatedly touching the 'view' shutter key.

NON-IMPLEMENTED SHUTTERS

In some systems, the 'top' and 'side' shutters are not BOTH implemented. In these cases, an appropriate message is displayed when an operation is attempted on a 'non-implemented' shutter. The first entry is set to "0" in the "TOPSHUT.00" or "SIDESHUT.00" files to specify a 'non-implemented' shutter.

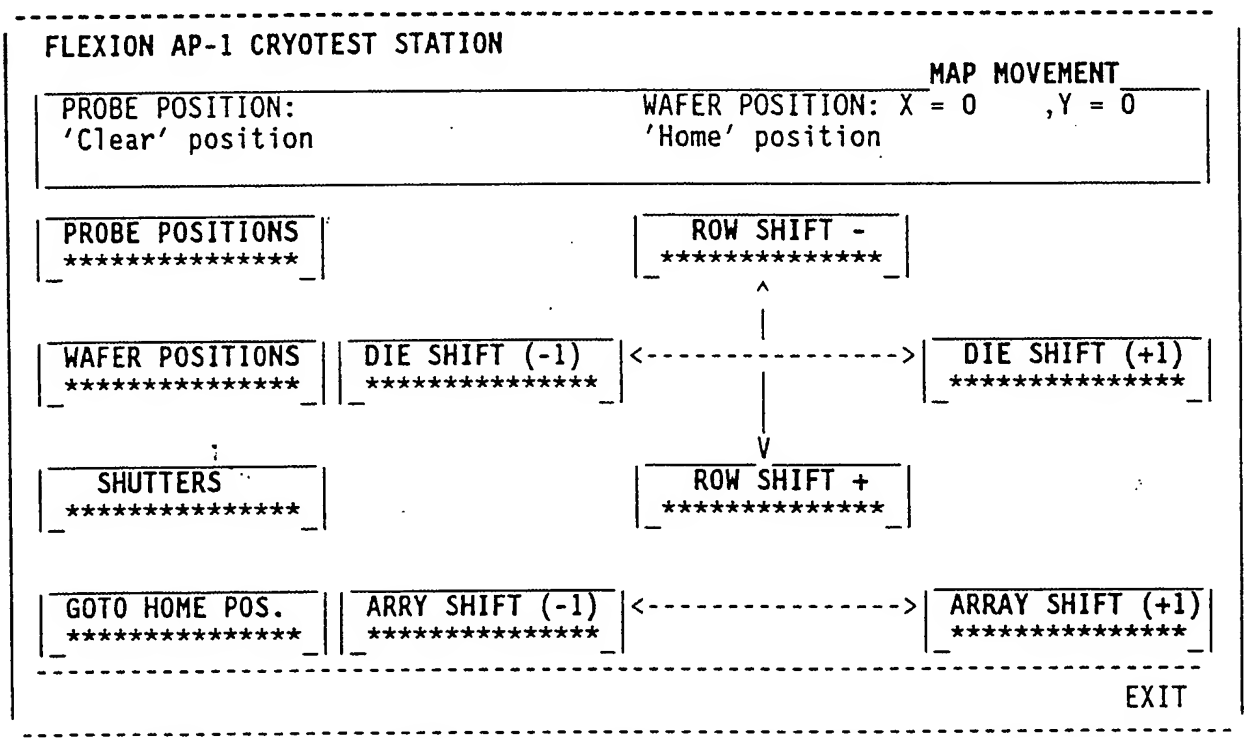
---------- end ----------

MAP MOVEMENT MENU DESCRIPTION (see notes 1 & 2)

This menu is activated by first touching the <MAP MOVEMENT> key on the "main menu" & then touching the <ENABLE> key.

This menu is used for manual control of the wafer position. That is, movement to those positions referred to by a die and array number, and which are defined by coordinates contained in the coordinate maps.

Once the wafer has been moved to the desired position, the operator uses this menu to move the probes down to their "test" ("over-travel" from zero) position or their "zero" (just touching) position. The probes are automatically raised to their "clear" position whenever the wafer is moved in the x or y direction. However, they may be raised manually.



note 1: In some systems the "DIE SHIFT (+-)" label is replaced by the "TP SHIFT (-+)" label. In these systems, the "die" positions are referred to as "'test' positions".

note 2: Some systems do not have "arrays" ,i.e. sub-positions within each die or test position. In these cases, the <array shift> keys may not be visible on the screen.

MAP MOVEMENT MENU (con't.)

If the AP-1 program has been setup with a z-offset map, then the corresponding offset values for each die position from the z-map will be automatically added to the previous set 'zero' & 'test' probe positions.

With a z-map enabled, movement to the 'zero' & 'test' positions is allowed only if the wafer is at a SPECIFIC map location. Probe movement to the 'clear' position is always allowed.

This menu may also be used to position the wafer to its "home" or "centered" position for purposes of loading or unloading.

The x and y movements are inhibited whenever the "zero" & "clear" positions of the probes have not been "set" (see "XYZ Manual Move Menu"). Also, all XY movement except "GOTO HOME POS.", is inhibited if the "DIE #1 POSITION" has not been "set".

THE 'GOTO HOME POSITION' KEY

To cause the wafer to go to its "home" or "centered" position, the <GOTO HOME POS.> key is touched. There is then one "action" choice displayed at the bottom of the screen, i.e. "start". The <START> key is touched to cause the movement to the "home" position to commence.

The movement to the home position, as well as movement to any position, occurs simultaneously on both the X and Y axes, as required.

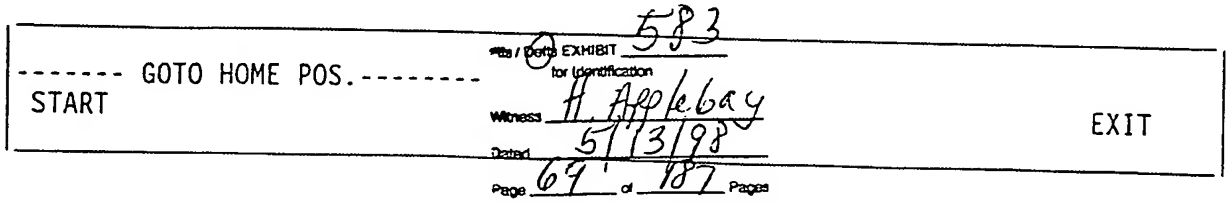
When the wafer has moved to its "home" position, the operator is informed with a message in the "status area" (upper box area).

If the wafer has not obtained the "home position" within a preset time, the action is aborted & the operator informed. In addition, the operator is informed if the movement of the wafer is inhibited by virtue of a limit-switch actuation.

Movement to the "home" position is inhibited if the "home" position has not been previously "set" in the "XYZ MANUAL MOVE" menu.

When the wafer is at the 'home' position AND the z-map is enabled, probe movement to the 'zero' & 'test' positions is prohibited - since this wafer position is NOT a specific map location.

To return from the "goto home position" function, the <EXIT> key is touched.



THE 'PROBE POSITIONS' KEY

To select & cause movement to one of the three preset probe positions, the <PROBE POSITIONS> key is touched.

The "action" choices are <CLRpos>, <ZEROpos>, & <TESTpos>. Touching any of these keys causes immediate movement to the requested position.

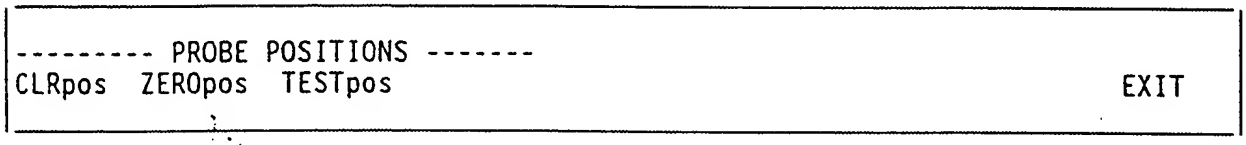
If the AP-1 program has been setup with a z-offset map, then the corresponding offset values for each die position from the z-map will be automatically added to the previous set 'zero' & 'test' probe positions.

The completion of any of these movements causes a status message indicating the actual probe position in the "status area".

The non-attainment of the requested position within a preset time will cause an appropriate message to be displayed, & the action aborted.

Movement to the "test" and "zero" positions is inhibited if the system is not at vacuum; or if the wafer is not at a specific map location when the z-map is enabled.

Movement to the "test" and "clear" positions is inhibited if they have not been previously "set" in the "XYZ MANUAL MOVE" menu.



THE "WAFER POSITION" DISPLAY

This display, which is located in the "status area" box, shows the current position of the wafer, in number of steps that the wafer had to take, from the previously established "home" position, to bring the required die under the probe assembly. Each step is .0001 inches.

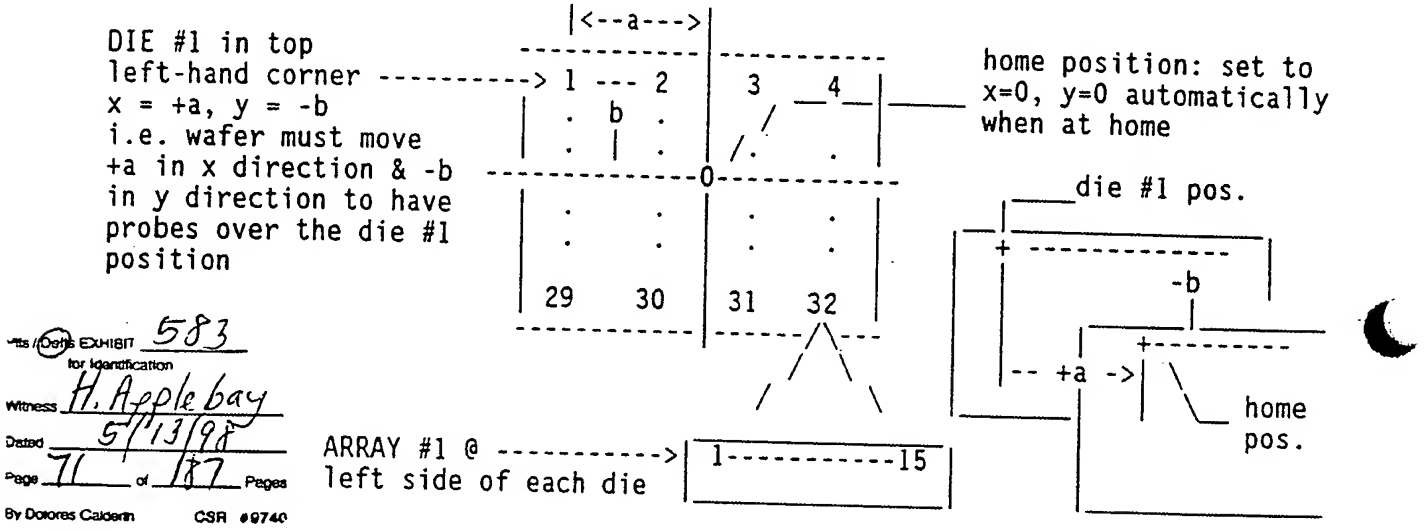
The actual x & y position is updated after the completion of all moves, regardless of whether the requested position was successfully achieved.

MAP MOVEMENT MENU (cont.)

THE "WAFER POSITION" DISPLAY (cont.)

The drawing below explains the x,y coordinate system as seen by the operator: It uses, as an example, a wafer with a die configuration of 4 X 8; and an array configuration of 15 'sub-positions' per die.

Remember that the probes are stationary and that the wafer must move to bring the desired die under the probes. Also note that the probe assembly is centered about the wafer 'home' position.



MAP FILES

The coordinates for all die & array positions are contained in a set of "maps" resident on the "RAM" disk. When the "map movement" menu is first downloaded, the data from these maps is transferred to the program memory, making it available for use in the program.

For verification purposes, the map identification numbers are shown in the "status area" until a X or Y movement occurs.

These maps were produced during the execution of the "setup" program using the 'map coordinate setpoints' previously programmed; or the "random" map files if so enabled.

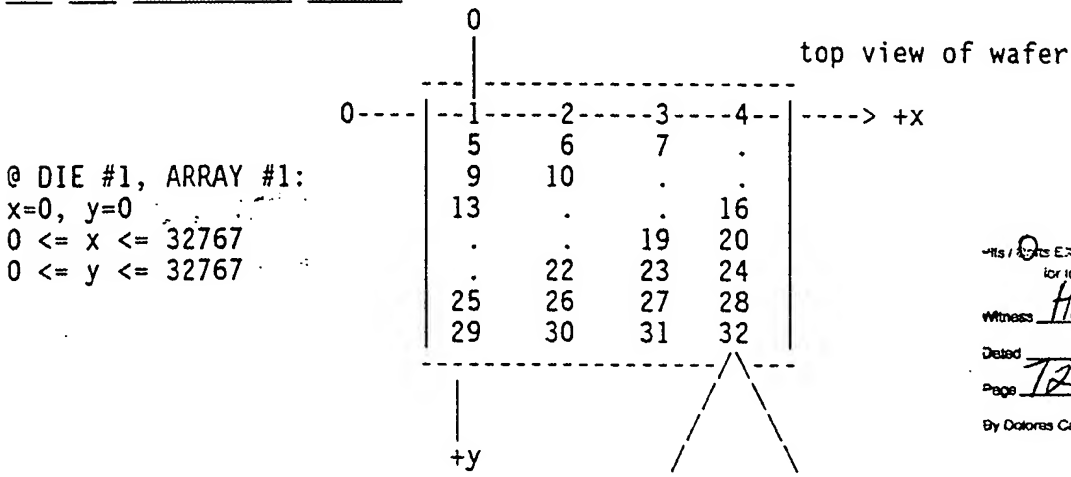
The x,y coordinate system for data in the die and array maps is slightly different than that used for display purposes. Where as the displayed x & y position is the number of steps moved by the wafer to bring the desired die under the probes, the x & y positions in the die maps are the displacements of each die from the die #1 location on the wafer.

MAP MOVEMENT MENU (con't.)

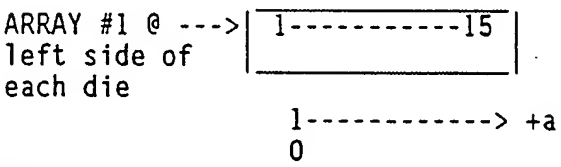
MAP COORDINATE SYSTEM

If there is an array map, the coordinates in the x-direction die map are the locations of array #1 in each die, starting at die #1. All coordinates are with respect to the die #1, array #1 position.

DIE MAP COORDINATE SYSTEM



ARRAY COORDINATE SYSTEM



ARRAY #1: a = 0
0 < =a < = 32767

THE 'WAFER POSITIONS' KEY

To initiate movement (from wherever) directly to either corner of the wafer , or to either end of the array, the <WAFER POSITIONS> key is touched.

Seven "action choices" are then displayed. Each of these choices, when touched, will cause immediate movement to the location indicated.

------- WAFER POSITIONS ---------				------- PROBE POSITIONS -------			
DIE#1pos	DIEend	ARY #1pos	ARYend	CLR pos	ZEROpos	TESTpos	EXIT

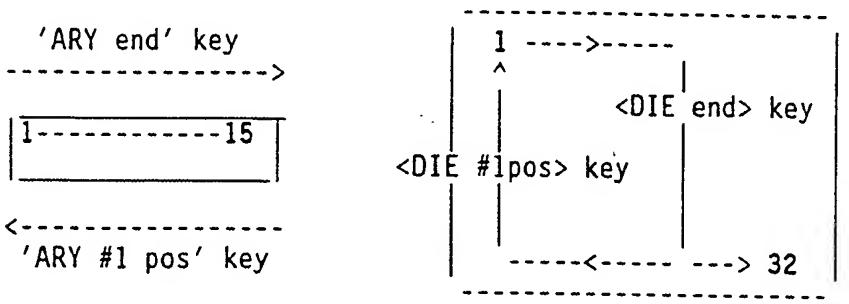
After the movement to the requested location is completed, the computer will display an appropriate status message and put the values of the actual test position in the "status area".

Notice that the probes may be moved to their various positions while in the "wafer positions" function. These probe-position keys function identical to those described previously.

MAP MOVEMENT MENU (con't.)

Notice that the probes may be moved to their various positions while in the "wafer positions" function. These probe-position keys function identical to those described previously.

A graphic description of the 'wafer positions' function is shown below:



THE 'DIE SHIFT' KEYS

The <DIE SHIFT(-1)> & <DIE SHIFT(+1)> keys are used to increment the wafer to the die immediately to the left (-x direction) or to the right (+x direction) of the current die, respectively. If the current die is at right or left side of the wafer then the movement will "wrap-around" to the next appropriate die location on the opposite side of the wafer (see diagrams below). Movement to a new die position, does not change the current array position, which remains the same until changed with the <array shift> keys.

THE 'ROW SHIFT' KEYS

Likewise, the <ROW SHIFT -> & <ROW SHIFT +> keys are used to increment the wafer to the die immediately above (previous row) or immediately below (next row) the current die. If the current die is at the 'top' or 'bottom' of the wafer, the movement will "wrap-around" to the die location on the other end of the wafer (see diagram below).

Due to the die numbering scheme of the wafer, movement in the y direction increments the die number by an amount determined by the map configuration.

Movement to a new die will commence immediately when the <START> key is touched. During movement to a new position, the computer displays its intended destination until the position is actually achieved.

At the completion of any movement, the computer displays an appropriate status message & updates the current die, array, & row position in the "status area".

MAP MOVEMENT MENU (con't.)

The probes may be moved to their various positions while in the "die shift" or "row shift" functions. These probe position keys function identical to those described previously.

A graphic description of the "die" & "row" movements is presented in the example below:

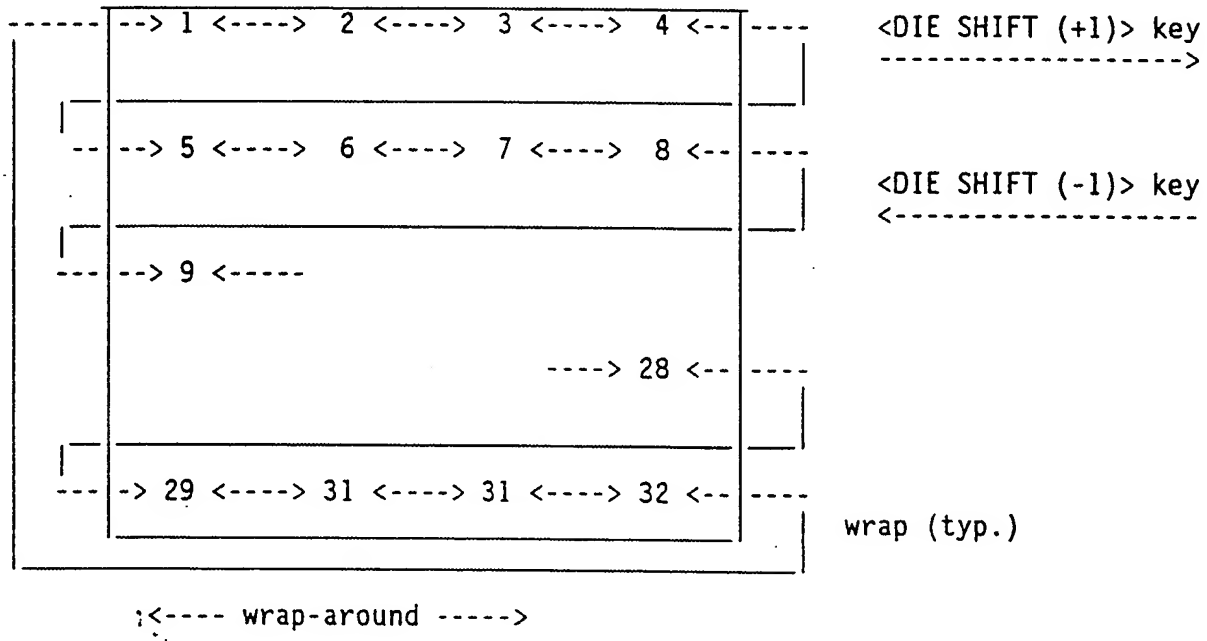


Exhibit 583
for identification
Witness H. Apolebay
Dated 6/13/98
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MAP MOVEMENT MENU (con't.)

THE 'ARRAY SHIFT' KEYS

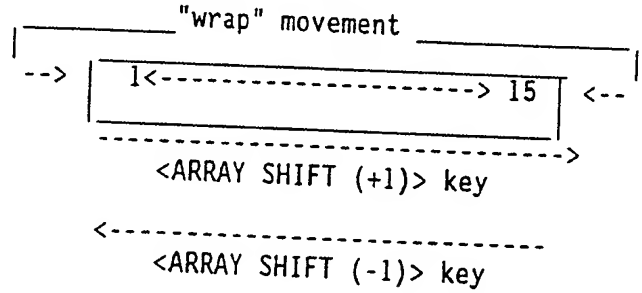
Whenever the <ARRAY SHIFT(-1)> or the <ARRAY SHIFT(+1)> keys are touched, a number of "action choices" are displayed.

------- ARRAY SHIFT (+1) -------	------ Probe Positions -----			
START	CLRpos	ZEROpos	TESTpos	EXIT

------- ARRAY SHIFT (-1) -------	------ Probe Positions -----			
START	CLRpos	ZEROpos	TESTpos	EXIT

When this <START> key is touched, the wafer will immediately move in either the "+" or the "-" x-axis direction, as selected, to increment the wafer position to the adjacent "array" (i.e. sub-position within the SAME die). Using the example presented previously, if the current array number is 15 and the direction of motion is "+", then the new array number will be 1, i.e. the array shifting movement "wraps around". A similar "wrapping" action will occur in the other direction when the wafer position at array # 1 and a "-" direction requested.

The array movements are shown graphically in the example below:



As the wafer is incremented to each array position, the "status area" is updated with the current array number, plus the current die number (which would not change in this case).

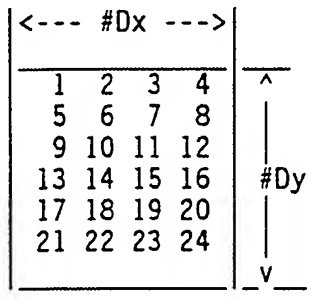
To discontinue the array shifting, the <EXIT> key is touched, at which time, another map movement function may be selected.

"Array shifting" is inhibited if the value for the "array number" has been set to 1 in the "SETPOINT" menu; or if the "array number" has been set to 0 in the "setpoint" file.

Notice that the probes may be moved to their various positions while in the "array shift" function.

MAP MOVEMENT MENU (con't.)

With "standard" or uniform map configurations, the die numbering scheme is straight forward. That is, "die #1" is the top-left die, dies are numbered left to right in each row, & the "last" die is at the bottom-right. There is, therefore, a "matrix" of dies, i.e. "#Dx" dies wide by "#Dy" dies high. An example is shown below:

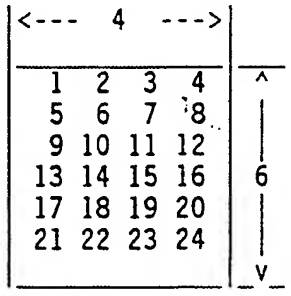


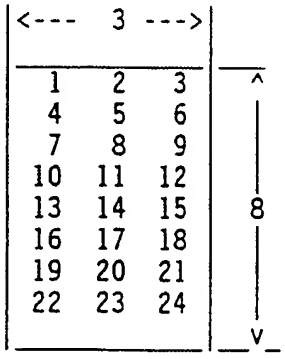
"MATRIX": #Dx = 4
#Dy = 6

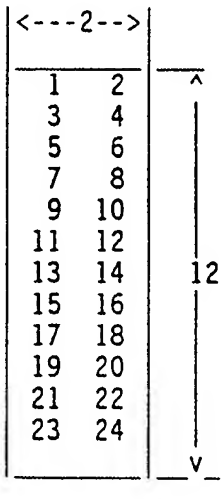
In the case of "standard" map configurations, the "matrix" corresponds exactly to the actual physical arrangement of dies on the wafer.

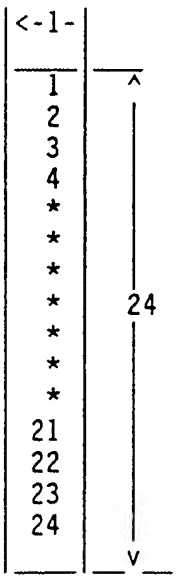
In the case of "random" map configurations, there is not, necessarily, a correspondence between the actual physical die arrangement and the "matrix" arrangement that is used by the map menu.

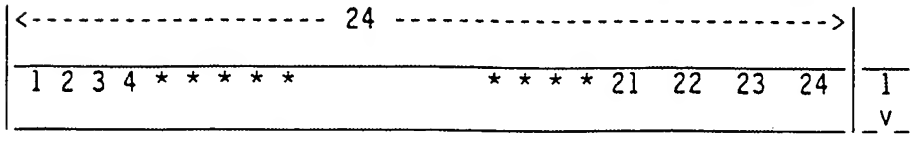
Using as an example, a wafer with a "random" map configuration, having a total of 24 dies, the following "matrices" can be defined :











MAP MOVEMENT MENU (con't.)

These different "matrices " are defined by setting the "number of dies, x-axis" & the "number of dies, y-axis" setpoints to the appropriate values in the "SP.01" file. The only constraint is that the product of these two setpoints equal the total number of dies.

Each "matrix", in effect, defines the movement that will be taken by the wafer when the "die shift +-" and the "row shift +-" functions are used. For example, the following die movements take place for the functions listed below: (all examples start with the wafer at the die #1 position)

	Matrix				
Functions	2 x 12	4 x 6	1 x 24	3 x 12	24 x 1
"die shift +"	1 to 2,3,4,..... (all examples are the same)				
"die shift -"	1 to 24,23,22,21,..... (all examples are the same)				
"row shift +"	1 to 3,5,7,.....	1 to 5,9,13,17,.....	1 to 1,2,3,4,.....	1 to 4,7,10,13,.....	1 to 1
"row shift -"	1 to 23,21,....	1 to 21,17,13,9,.....	1 to 24,23,22,.....	1 to 22,19,16,.....	1 to 1

There is no difference in movement, in the examples above, for the "die shift +-" functions. However, there are substantial differences in the movements for the "row shift +-" functions.

The user must decide on the "matrix" arrangement when the die maps are defined. For "standard" or "non-random" maps, the "matrix" will correspond to the actual physical arrangement. For "random" maps, the matrix chosen should result in the most appropriate die movement within the map movement menu.

MAP MOVEMENT MENU (con't)

OPERATING THE SHUTTERS

Shutter operation is activated by touching the <SHUTTERS> key on the xyz manual movement menu. After touching this key, a set of keys corresponding to the three shutters and their various positions is displayed at the bottom of the crt screen.

If a '2-position' shutter if specified, the 'FILTER' legend will not appear - and only two positions of the top shutter will be possible. See the document "Addendum: The 'Top' and 'Side' Shutter Files" for information on configuring the shutters.

The actual state of each shutter is indicated by the appropriate position being enhanced with a bright inverse label. An unknown shutter condition is indicated by no enhanced shutter position.

-----TOP SHUTTER------			-VIEW-	-------SIDE SHUTTER--------			
CLOSED	FILTER	OPEN	CLOSED	CLOSED	FILTER 1	FILTER 2	EXIT

To set the 'top' and 'side' shutters to a desired state, the appropriate label is touched. These two shutters have feedback inputs which indicates the true position of the shutter. These feedback inputs are checked after each shutter movement to assure that the shutters have moved to the requested position. If the feedback indicates that the shutter has not moved to the required position within a preset time, an appropriate message is displayed in the "status" box on the crt display.

The "close" and "filter" positions of the top shutter are inhibited if the "wafer-access lid" is not down. In addition, the top shutter is automatically reset to the 'open' position whenever the wafer access lid is raised.

The 'view' shutter is set to either 'open' or 'closed' by 'toggling' the shutter state by repeatedly touching the 'view' shutter key.

NON-IMPLEMENTED SHUTTERS

In some systems, the 'top' and 'side' shutters are not BOTH implemented. In these cases, an appropriate message is displayed when an operation is attempted on a 'non-implemented' shutter. The first entry is set to "0" in the "TOPSHUT.00" or "SIDESHUT.00" files to specify a 'non-implemented' shutter.

------- end ---------

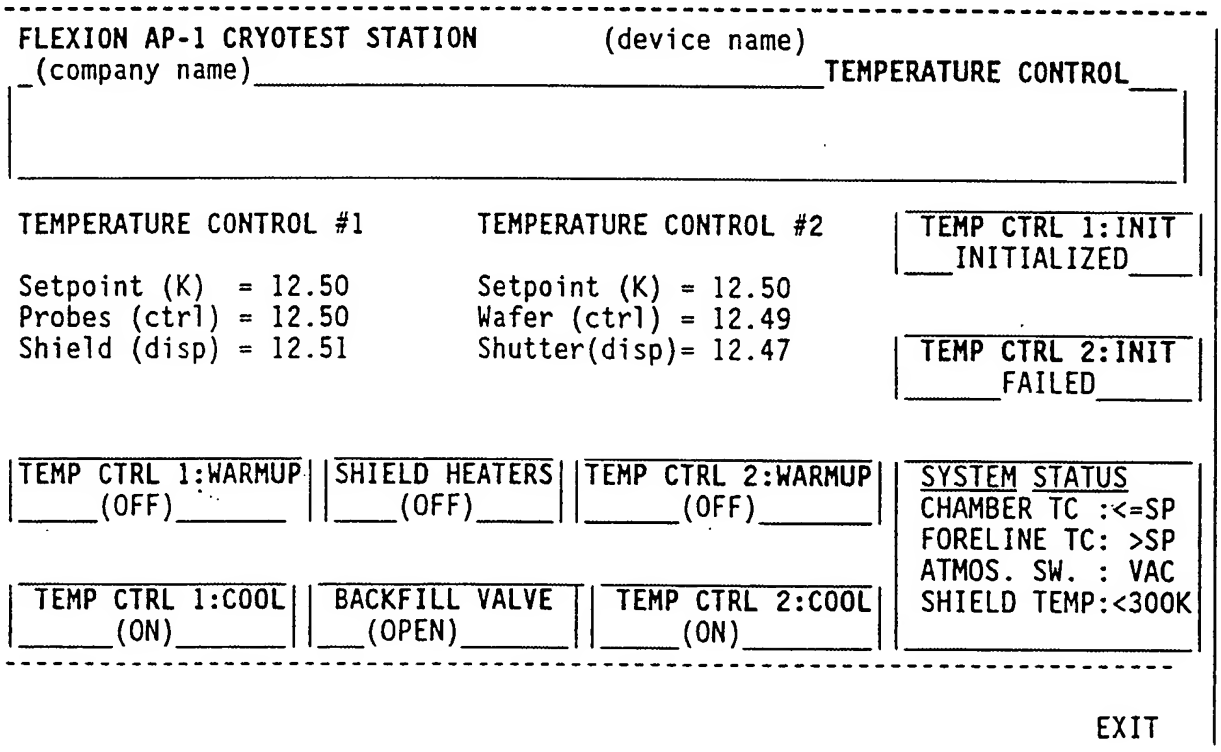
TEMPERATURE CONTROL MENU DESCRIPTION

MENU FUNCTIONS

The temperature control menu is obtained by touching the <TEMP CTRL> key followed by the <ENABLE> key on the main menu display.

This menu is used to control the initialization, cool down, and warm up of each of the two temperature controllers attached to the HP150II computer via the HPIB bus.

This menu is also used for controlling the shield heaters and the backfill valve.



TEMPERATURE CONTROL MENU DESCRIPTION (continued)

THE SYSTEM STATUS BOX

Included on this menu is a status display of various system conditions, namely (1) chamber thermocouple setpoint indication, (2) foreline thermocouple setpoint indication, (3) atmosphere switch indication, and (4) shield room temperature indication switch. The state of these system inputs is updated in the "system status" box at a frequency of once every four seconds.

In the case of the chamber and foreline thermocouple setpoints, the label "<=SP" is used to indicate a pressure value that is equal to or lower than the setpoint, whereas the label "> SP" is used to indicate a pressure value greater than the setpoint value.

The atmosphere indication switch is used to indicate that the chamber is at atmospheric pressure. The label corresponding to this condition is "@ ATMOS", whereas the label corresponding to a vacuum condition is "VAC". If the atmosphere switch does not indicate atmosphere and the chamber tc does not indicate a pressure less than the setpoint then the display will indicate a status of "< ATMOS".

The state of the shield temperature switch is indicated as follows: if the temperature is greater than or equal to 300 K then the label used would be "=>300 K", if the shield temperature is less than 300 K the label will be "<300K".

OPERATING THE BACKFILL VALVE

To operate the backfill valve, the <BACKFILL VALVE> key is touched. The operator is then presented with a set of "action" choices which are active immediately when touched. The action choices in this case are <OPEN> or <CLOSE>. The current state of this valve is indicated in the touch-key box.

If the system is at atmosphere, the opening of the backfill valve is disabled. In addition, if the backfill valve is open when the system pressure obtains an atmospheric level, then the backfill valve is automatically closed.

While the backfill valve is open, an exit from the "temperature control" menu is prohibited.

TEMPERATURE CONTROL MENU DESCRIPTION (continued)

OPERATING THE SHIELD HEATER

To actuate the shield heat function the <SHIELD HEATERS> key is touched. The two action choices then presented to the operator are <ON> and <OFF>. Touching either of these keys will immediately affect the appropriate action. The current state of the shield heater is indicated in the touch-key box.

Turning the shield heaters on is inhibited if the temperature is greater than or equal to 300 K. In addition, if the shield heaters are on, they will be turned off automatically when the temperature reaches 300 K.

While the shield heaters are on, an exit from the "temperature control" menu is prohibited.

In addition, the shield heat function is enabled ONLY when the probes are in their fully-up position.

TEMPERATURE CONTROLLER INITIALIZATION

Before the temperature controllers can be used they must be "initialized". This is a process of sending various parameters to the temperature controllers via the HPIB bus.

All initialization parameters that are sent down to the temperature controllers are read back and checked against what was sent. If any discrepancy occurs during this checking process, or if there is any other problem such as a lack of response from the temperature controllers within a preset time, the initialization process is said to have "failed". This indication is displayed in the <TEMP CTRL 1: INT> and the <TEMP CTRL 2: INT> touch-key blocks.

If the initialization process fails, the "cooling" and "warm up" functions of the corresponding temperature controller are inhibited. The initialization process may be tried as many times as may be required.

The actual initialization commands & parameters sent down to the two temperature controllers are listed below:

1. An initial "clear" command
2. Heat range = off
3. End of transmission equal to "line feed" and an EOI indication
4. Set remote mode
5. Select the display of "sensor A"
6. Set the "sensor ids" equal to values set in the "SW-FLAGS.00" file.
7. Set the temperature setpoint for both = default value (12.50 K), or to value previously programmed in the "setpoint" file.
8. Set the 'Gain' setpoint for both = default value (50), or to value previously programmed in the "setpoint" file.

TEMPERATURE CONTROL MENU DESCRIPTION (continued)

9. Set the 'Reset' setpoint for both = default value (2), or to value previously programmed in the "setpoint" file.
10. Set the heat range for both = 'minimum' (.25W)

The initialization process performed from this menu should not be confused with the HPIB bus checkout that is performed when the HP150 is powered up. The power-up procedure is designed to verify that the temperature controllers are indeed connected to the HP150 and can communicate with the HP150 computer over the HPIB bus.

THE ACTUAL TEMPERATURE DISPLAY

Included in this menu is a display of the current temperature setpoint and the two monitored temperatures for each temperature controller. These values are obtained from the actual temperatures controllers and are displayed on the crt screen once every four seconds. This update process, for a particular temperature controller, is inhibited until its initialization process passes.

For the 'Model 805', to obtain both 'A' and 'B' sensor data, the HP150 alternately toggles the temperature controller's display between the 'A' and 'B' sensor every 4 seconds. This is necessary in that only the 'displayed' temperature is obtainable via the HPIB bus!

Note: The temperature display is always set to display the 'A' sensor when the temperature menu is exited.

The actual temperature display during the "cooldown" and "warm-up" process is automatically outputted to an external serial printer. This print-out can be disabled if the appropriate software flag has been set to '0' in the "SW-FLAGS.00" file. The frequency of this print-out is at one minute intervals. The printout will continue indefinitely until the temperature menu is exited.

It is not required that a printer be attached to the HP150 whenever the printout is enabled. The program will still send the data out the serial port, but expects no response back from the receiving device.

TEMPERATURE CONTROL MENU DESCRIPTION (continued)

An example of the print-out follows:

```
CALENDAR DATE:  12-03-1986   CLOCK TIME:  16:28:23


 TOTAL ELAPSED TIME (min):  1.011003

 SETPOINT TEMP., CONTROLLER # 1:  012.50
 PROBES:  012.43
 SHIELD:  011.98
 SETPOINT TEMP., CONTROLLER #2:  012.50
 WAFER:  011.72
 SHUTTER:  012.51
```

STARTING THE COOLDOWN PROCESS

The cooldown process is initiated by first touching the <TEMP CTRL 1: COOL> or the <TEMP CTRL 2: COOL> key. A set of action choices is then displayed. These are <ON> or <OFF>. Through use of these keys one can initiate a cooldown process to the low-temperature setpoint value.

The following actions take place with respect to the temperature controllers when the cooldown process is initiated:

1. The appropriate temperature setpoint is sent down to the temperature controller, read back, and checked for equivalence.
2. The temperature controller "on state" is set by sending the appropriate "heat range" value. This value is also read back and checked for equivalence.

The following action takes place with respect to the temperature controllers when either the cooldown or warm up process is terminated by touching the <off> key:

1. The temperature controller "off state" is set by sending the appropriate "heat range" value. This value is also read back and checked for equivalence.

The ON/OFF state of the cooldown process is indicated in the appropriate touch-key box.

STARTING THE WARM-UP PROCESS

The warm-up process is initiated by first touching the <TEMP CTRL 1: WARMUP> or the <TEMP CTRL 2: WARMUP> keys. A set of two action choices is then displayed, i.e.<ON> and <OFF>.

Touching the <ON> key will immediately start the warm-up process by sending a setpoint value of 300 K to the temperature controller, i.e. room temperature, and by setting the temperature controller to the "on" state.

Touching the <OFF> key will immediately terminate the warm-up process by turning off the temperature controller.

With respect to the commands sent to the temperature controller to initiate and terminate the warm-up process, the only difference between these commands for warm-up and those for cooldown, is the value of the "on state" setpoint. That is, an "on" value of 300 K for warmup and an "on" value of "whatever" has been programmed for cooldown.

PROBE POSITION CONSIDERATIONS

Due to physical changes in the relative probe to wafer position when the system temperature is changed, the initiation of the "warmup", "cool", and "shield heat" functions is inhibited if the probes are not at their fully-up or "home" position.

Likewise, whenever the system temperature is changed through use of the "warmup", "cool", or "shield heat" function, the operator will be required to re-establish the "zero" position of the probes. Until this is done, the probes cannot be "sent" down to a "zero" or "test" position that may no longer be appropriate.

REMOVING POWER FROM THE TEMPERATURE CONTROLLERS

Normally the temperature controllers are in the "remote" mode. The operator should NOT switch the temperature controllers back to the local mode. In the remote mode, the HP150 controls the value of the setpoints, regardless of the setting of the temperature setpoint thumbwheel switches or the response knobs on the front of the temperature controllers.

However, the following warning must be made:

THE TEMPERATURE SETPOINT WILL CHANGE TO THE VALUE ON THE THUMBWHEEL SWITCHES IF THE POWER TO THE TEMPERATURE CONTROLLER IS MOMENTARILY TURNED OFF or IF THE LOCAL MODE IS ENTERED!!!

Upon power-up, the temperature controllers go automatically to the "local" mode. These "local" setpoint values will remain as the active values when the temperature controllers are manually put back into the "remote" mode! These setpoint values will remain active until the HP150 is instructed to turn on the "cool" or "warmup" process. At which time, the temperature setpoint value will change back to the HP150 preprogrammed low-temperature setpoint value or 300 K, respectively.

THEREFORE, DO NOT TURN THE POWER TO THE TEMPERATURE CONTROLLERS OFF WHILE THE HP150 IS CONTROLLING THE SYSTEM!

THE "INITIALIZATION" FUNCTION SHOULD BE PERFORMED IF THE POWER HAS BEEN REMOVED FROM THE TEMPERATURE CONTROLLERS.

-------- end ----------

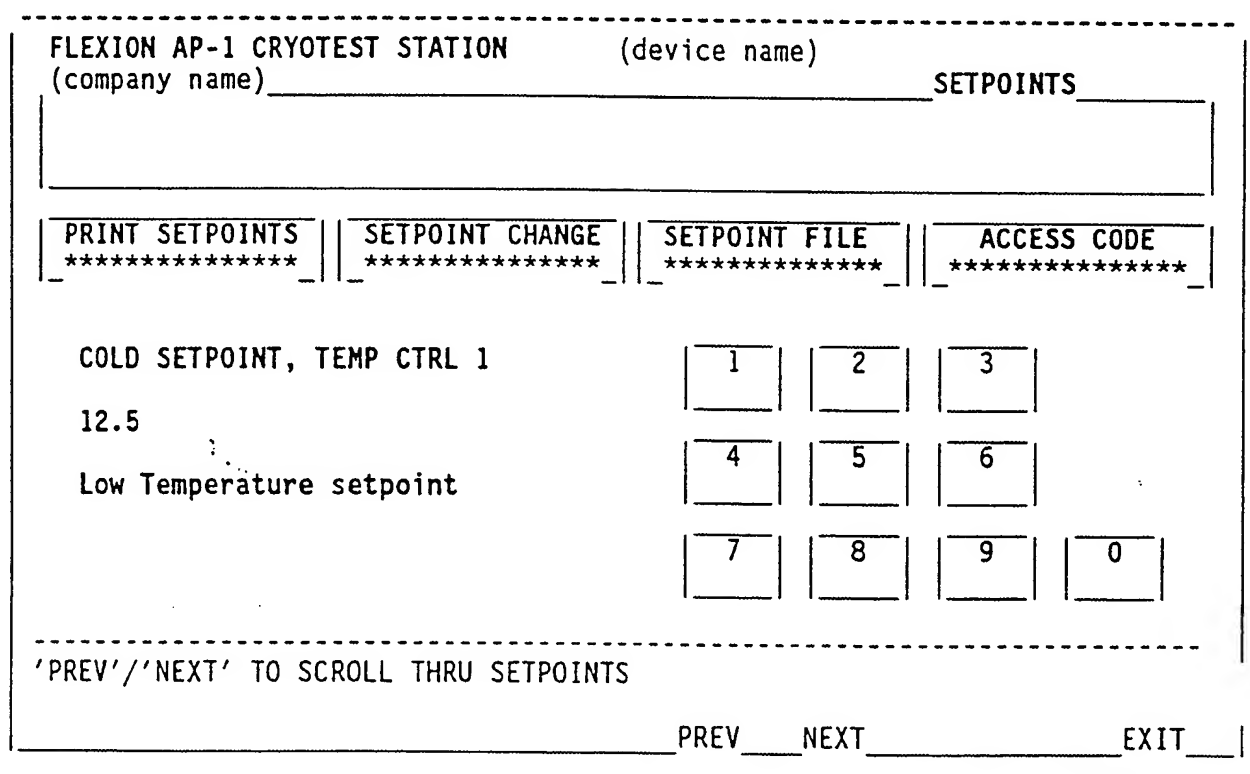
SETPOINT MENU

The "setpoint" menu is entered by first touching the <SETPOINTS> key followed by the <ENABLE> key on the "main" menu. This menu is used to list, print, and/or change the current values of the setpoints.

The following parameters for the temperature controllers are programmable:

(1) The low temperature control setpoint, the "cold setpoint".
(2) The "proportional", i.e. "gain" setpoint
(3) The "integral", i.e. "reset" setpoint

The "warmup setpoint" for both temperature controllers is fixed at 300 K. Likewise, the setpoint for the "power range" is fixed at 0.25 W max.



SETPOINT MENU (cont.)

The programmable parameters associated with the die & array maps are: (see note 1)

(1) The "x-axis die increment" , i.e. the number of steps between like elements on each die in the x-axis direction.
(2) The "y-axis die increment" , i.e. the number of steps between like elements on each die in the y-axis direction.
(3) The "x-axis die number", i.e. the total number of dies in the x direction
(4) The "y-axis die number", i.e. the total number of dies in the y direction.
(5) The "array increment", i.e. the number of steps between array elements on each die in the x-axis direction.
(6) The "array number", i.e. the total number of array elements in each die.

The programmable parameters associated with z-axis stepping are:

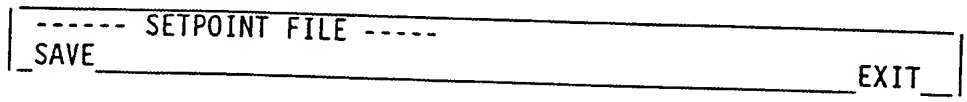
(1) The probe "close" position, i.e. the number of steps down from the probe upper limit switch (i.e. home position) that represent a position "close" to the wafer surface.

(2) The probe "max-down" position, i.e. maximum number of steps allowed down from the probe "home" position.

(3) The probe "minimum-clear" position, i.e. the lowest level that the "clear" position may be set while in the "xyz" menu.

SAVING SETPOINTS

Selecting the <SETPOINT FILE> key will display the following "action choice":



Touching the <SAVE> key will cause the saving, to the disk in drive A, of all current setpoint values, thereby changing the power-on default values to the current values. If the HP150 power is removed, before touching the <SAVE> key, all current setpoint values will be lost.

note 1: In some cases, the 'die' positions may be more appropriately called 'test' positions. In these cases, 'die' labels will read 'test' position or 'TP'.

SETPOINT MENU (cont.)

Each time an acceptable value for any of the map coordinates is "entered", the appropriate die-coordinate map is re-computed & re-saved on the "C-drive" RAM disk. Therefore, the new map files will be effective until the power is removed from the computer. To change the power-up default map configuration, one must "save" the map coordinate data using the <SAVE> key.

ABORT CONDITIONS WHILE 'SAVING' SETPOINTS TO DISK

THE "PROGRAM" DISK SHOULD ALWAYS BE IN DRIVE A AND READY FOR SAVING OF THE SETPOINTS and THE DISC SHOULD NOT BE WRITE-PROTECTED.

If the "program" disk is 'write-protected' or is not in drive A , and the operator attempts to 'save' the setpoints, the setpoint menu program will indicate an "abort" condition to the user. When this condition occurs, and before any other action is taken, the disc should be installed in drive A with the 'write-protect' feature disabled (see note 2). The setpoint 'save' operation should then be repeated. **No other action should be taken between the indication of an 'aborted save' operation and the re-saving of the setpoints with the abort cause rectified.**

If the procedure described above is not followed exactly, it is possible, especially if the setpoint menu is exited, to cause a termination of the AP-1 program. This program termination is caused by an un-diagnosed bug in the compiler program used to produce the AP-1 program. Until this bug can be solved or avoided, care must be taken if an 'abort-save' condition occurs.

SPECIFICALLY, DO NOT IMMEDIATELY EXIT THE SETPOINT MENU IF AN 'ABORT' CONDITION OCCURS WHILE SAVING THE SETPOINTS TO DISK. First fix the problem. That is, install the 'program' disc in drive A and disable the 'write-protect' feature. Then repeat the save operation again. **ONLY AFTER THE SETPOINTS HAVE BEEN SAVED SUCCESSFULLY SHOULD THE SETPOINT MENU BE EXITED.**

note 2: The disc is 'write-protected' whenever the small tab at the top corner of the disc case is positioned so that there is an opening in the disc case. To disable the 'write-protect' feature, slide the tab back towards the center of the disc so that the opening is closed.

REVIEWING THE CURRENT VALUES OF THE SETPOINTS

To view the current values of all setpoints, in a sequential manner, the <NEXT> and <PREV> keys are touched repeatedly. The name of the each setpoint, its current value, and a description of the setpoint is displayed at the left-center area of the crt screen each time the <NEXT> or <PREV> key is touched.

The "access code" setpoint is not displayed on the crt during the viewing process if it has not been previously entered correctly.

PRINTING THE CURRENT SETPOINT VALUES

Touching the <PRINT SETPOINTS> key will cause the program to display a set of "action choices" at the bottom of the crt screen, as shown below:

```
------ SETPOINT PRINT -----
SETPTs  MAPS              STOP                    EXIT
```

The <SETPTs> key will initiate the printing of all current setpoints (with the exception of the access code) to a serial printer, i.e. if the print-out enable flag in the "SW-FLAGS.00" file has been set. Touching the <STOP> key, while printing is active, will terminate the printing process.

The <MAPS> key will initiate the printing of the current map coordinate data. That is, the relative position of all die and array positions with respect to the die #1, array #1 position. In addition, if the z-map is enabled, the z-map offset values, corresponding to each die position, will be printed.

At the beginning of each printout, if the appropriate "user-programmable" files have been made, the customer's "company name", "device name", and current date are printed.

SETPOINT PRINTOUTS (cont.)

EXAMPLE OF SETPOINT PRINTOUT (see note 1 above)

(company name) (device name)
(current date)

TEMPERATURE CONTROLLER #1 SETPOINTS

COLD SETPOINT, TEMP CTRL 1 = 12.5
Low temperature setpoint

GAIN, TEMP CTRL 1 = 50
'Proportional' setpoint

RESET, TEMP CTRL 1 = 2
'Integral' setpoint

PWR RANGE, TEMP CTRL 1, COOL = 1
maximum heat power

PWR RANGE,TEMP CTRL 1,WARMUP = 1
maximum heat power

TEMPERATURE CONTROLLER # 2 SETPOINTS:

COLD SETPOINT, TEMP CTRL 2 = 12.5
Low temperature setpoint

GAIN, TEMP CTRL 2 = 50
'Proportional' setpoint

RESET, TEMP CTRL 2 = 2
'Integral' setpoint

PWR RANGE, TEMP CTRL 2, COOL = 1
maximum heat power

PWR RANGE,TEMP CTRL 2,WARMUP = 1
maximum heat power

(Print-out continued on next page)

SETPOINT PRINTOUTS (cont.)

EXAMPLE OF SETPOINT PRINTOUT (see note 1 above)

DIE POS. INCREMENT, X-AXIS = 950
# of steps between die pos, in x-axis

DIE POS. INCREMENT, Y-AXIS = 400
# of steps between die pos, in y-axis

DIE POS. NUMBER, X-AXIS = 5
# of die pos in the x-axis

DIE POS. NUMBER, Y-AXIS = 5
# of dies pos in the y-axis

ARRAY INCREMENT, X-AXIS = 89
# of steps between array elements

ARRAY NUMBER, X-AXIS = 10
# of arrays in each die pos

PROBE Z-AXIS SETPOINTS:

PROBE 'MIN-CLR' POSITION = 100
min. steps for probe 'clear' pos.

PROBE 'CLOSE' POSITION = 500
steps: probe 'home' to 'close' pos.

PROBE 'MAX-Z' POSITION = 1000
maximum steps from probe 'home' pos.

EXAMPLE OF MAP PRINTOUT

(company name) (device name)
(current date)

DIE COORDINATE MAP

DIE MAP ID #1: 950, DIE MAP ID #2: 400

	X-POS	Y-POS
DIE # 1 :	0	0
DIE # 2 :	950	0
DIE # 3 :	1900	0
DIE # 4 :	2850	0
DIE # 5 :	3800	0
DIE # 6 :	0	400
DIE # 7 :	950	400
DIE # 8 :	1900	400
DIE # 9 :	2850	400
DIE # 10 :	3800	400
DIE # 11 :	0	800
DIE # 12 :	950	800
DIE # 13 :	1900	800
DIE # 14 :	2850	800
DIE # 15 :	3800	800
DIE # 16 :	0	1200
DIE # 17 :	950	1200
DIE # 18 :	1900	1200
DIE # 19 :	2850	1200
DIE # 20 :	3800	1200
DIE # 21 :	0	1600
DIE # 22 :	950	1600
DIE # 23 :	1900	1600
DIE # 24 :	2850	1600
DIE # 25 :	3800	1600

ARRAY COORDINATE MAP:

ARRAY MAP ID #: 89

ARRAY # 1 : 0
ARRAY # 2 : 89
ARRAY # 3 : 178
ARRAY # 4 : 267
ARRAY # 5 : 356
ARRAY # 6 : 445
ARRAY # 7 : 534
ARRAY # 8 : 623
ARRAY # 9 : 712
ARRAY # 10 : 801

SETPOINT MENU (cont.)

THE ENTRY of the "ACCESS CODE"

No change in the setpoint values is allowed until the correct "access code" is entered. The "access code" itself may be changed, but only after the entry of the current code value!

The enabling of setpoint change is only valid while in the setpoint menu. If the menu is exited, and then re-entered, the "access code" must be re-entered.

The default, or initial value of this "access code" is 0860, which corresponds to the last four digits of Flexion's telephone number.

To change the "access code", the <ACCESS CODE> key is touched. The operator is then shown a set of keys and directions at the bottom of the crt screen.

ENTER 4-DIGIT ACCESS CODE		
CLEAR	ENTER	EXIT

The "number" touch keys are used to enter the new "access code". As numbers are touched, they are displayed in the <ACCESS CODE> touch key box. Only four digits are allowed during entry, additional entries are ignored. If an error is made in entry, the <CLEAR> key is used to erase the previously entered numbers. Once the complete "access code" number has been entered, the <ENTER> key is touched. If the numbers entered are indeed the "access code", the operator is informed and setpoint change is enabled. However, if the entry is incorrect, the message "WRONG CODE !" is displayed in the <ACCESS CODE> touch key box.

To exit the "access code" mode, the <EXIT> is touched.

CHANGING A SETPOINT

To change the value of a particular setpoint, (including the "access code") it must first be displayed on the crt in the left-center area. To obtain the desired setpoint, the <NEXT> or <PREV> key is touched until the appropriate setpoint is displayed.

The operator is prohibited from changing any setpoint until the access code has been correctly entered.

SETPOINT MENU (cont.)

The setpoints associated with a temperature controller are still programmable even though the controller has not been "initialized." In this case, the program will change the values in the setpoint file, but will not attempt to send the changed values to the temperature controller itself.

If the z-map is enabled, the setpoints associated with the map 'configuration' are not programmable, i.e. the number of dies in the x and y directions.

If there is a "random" array map enabled, i.e. the "random-array-map" flag is set in the "software-flags" file, the "number of arrays" and the "array increment" setpoints cannot be changed.

If there is a "random" xy map enabled, i.e. the "random-die-map" flag is set in the "software-flags" file, the "number of dies, x-axis", the "number of dies, y-axis", the "die increment, x-axis", and the "die increment, y-axis" setpoints cannot be changed.

If the "number of arrays" setpoint has been set to zero in the "setpoint" file, changes to the "array increment" and the "number of arrays" setpoints are not allowed. This setpoint is set to zero whenever the system application requires no arrays.

Once the desired setpoint is displayed, the <SETPOINT CHANGE> key is touched. The operator is then given a set of additional keys to use, which are displayed at the bottom of the crt screen (see below).

```
------ SETPOINT CHANGE ------
CLEAR                ENTER                EXIT
```

The <CLEAR> key is used to erase, or blank, an entry that is not correct. The <ENTER> key is used to indicate to the HP150 that the current setpoint is to be changed to that which is displayed.

New temperature controller setpoint (values) are sent to the appropriate temperature controller when the <ENTER> key is touched. The setpoint value is then requested to be sent back to the HP150. The returned value is compared to the value initially sent. If they are not equal, the HP150 setpoint value is NOT changed - although the value may be changed in the temperature controller . In such a situation, the operator is informed with an appropriate message in the "status-box".

SETPOINT MENU (cont.)

ACCEPTABLE SETPOINT VALUES

There is an "maximum entry value" for each setpoint.,

In addition, if the new setpoint value is not within an acceptable range for the particular setpoint, as determined when the <ENTER> key is touched, the "entry process" is prohibited.

Specifically, the following conditions must be met before entry of a setpoint:

(1) The "access code" entry is prohibited from exceeding a value of 9999.
(2) The entry of values for the "gain" and "reset" setpoints is prohibited from exceeding 99.
(3) The entry of values for the "number of dies, x-axis" & "number of dies, y-axis" is prohibited from exceeding 99.
(4) The entry of values for "die increment, x-axis", & "die increment, y-axis" is prohibited from exceeding 9999 steps.
(5) The entry value for the low-temperature control setpoint is prohibited from exceeding 400K .
(6) The entry value for the "array increment, x-axis" is prohibited from exceeding 999.9 steps.
(7) The "number of array elements" cannot exceed 999.
(8) The entry value for the "probe 'close' position" may not exceed the current value for the "probe 'max-down' position."
(9) The entry value for the "probe 'max-down' position" may not exceed 2,000 steps.
(10) The entry value for the probe 'min-clear' setpoint must be between 100 and 500 steps.
(11) No map coordinate setpoint value may be set equal to zero.
(12) The product of the "die increment in the x-axis" times the "number of dies in the x-axis" must be less than 32000 steps. This is true also for the corresponding product in the y-axis.
(13) The product of the "array increment" times the "number of arrays" must be less than the "die increment in the x-axis".
(14) The entry of a value equal to 1 for the "number of array elements" will be accepted. However, if a value of 1 is entered, it will be interpreted as an indication that there are NO array elements on the dies.
(15) The product of the "number of dies,x-axis" and the "number of dies, y-axis" cannot exceed 500. That is, the maximum total number of dies cannot exceed 500.

SPECIAL SETPOINT CONSIDERATIONS:

CHANGING THE "ARRAY SETPOINTS

As indicated above, the product of the "array increment" times the "number of arrays" cannot exceed the "die increment, x-axis". This is so because, by definition, the "arrays" are "sub-positions" within each die. If either of the array setpoints are to be increased, it may be necessary to first increase the "die increment, x-axis". If the "die increment, x-axis" is to be reduced, it may be necessary to first reduce the array setpoints.

The value for the "array increment, x-axis" may be programmed to a resolution of 0.1 steps. However, the program can only step to a resolution of 1 step. As a result, the program produces an "array map" where the value for each array position is the "rounded sum" of the array increments to that position. That is, for the third position of an array having an increment of 35.6 steps, the resultant number of steps would be 107 steps (3 x 35.6 = 106.8, rounded to 107). This method yields increased resolution of position - without "accumulated" error.

CHANGING THE "LOW-TEMP." SETPOINT - RESOLUTION CONSIDERATIONS

The value for the "low-temperature setpoint" may be programmed to a resolution of 0.1 K. Although the temperature setpoint resolution is 0.1 K, the temperature controller reads the "actual" temperature to a resolution of +- 0.01 K. Actual temperatures to this resolution are displayed in the "TEMPERATURE CONTROL" menu.

INDIRECT EFFECTS OF CHANGING SETPOINTS

Changing the probe "close" or "max-down" position setpoints will cancel the current probe "zero" setting. This will necessitate a re-setting of the probe "clear", "zero", and "test" positions.

Changing the x or y maps will cancel the current wafer "die #1 pos." setting. This will necessitate a re-establishment of the "die#1 pos."

CHANGING THE 'GAIN' & 'RESET' SETPOINTS

These setpoints may range from 99. to 0.1 . The maximum number of digits allowed is 3, counting the decimal point as a digit! The program will automatically inhibit the entry of more than three digits for these setpoints.

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for identification
Witness H. Appleberry
Dated 5/13/98
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for Identification
Witness H. Appleby
Dated 5/13/98
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By Dolores Calcaterra CSR #9740

PROBE AND WAFER SETUP PROCEDURE

This procedure is designed to lead an operator through the steps required to setup the probe and wafer positions in the Flexion AP-1 Cryotest Station, in preparation for a "test-cycle" by a remote host computer.

To understand the steps set forth in this procedure, it is required and assumed, that the operator has read the various menu descriptions available.

IT IS NOT ADVISABLE TO PROCEED ON WITH THIS PROCEDURE WITHOUT FIRST READING THE MENU DESCRIPTIONS.

This procedure can be divided into three interrelating steps i.e. (1) setting the probe positions, (2) setting the wafer positions, (3) adjusting the rotational angle of the wafer (i.e. theta angle).

The three steps outlined above may be performed at room temperature, but MUST be repeated when the system has stabilized at the "cool temperature" setpoint.

After the probe and wafer have been setup as outlined, the operator may then choose to allow the host computer to have complete control of the probe and wafer movements by entering the "host control" mode via the "remote mode" menu. Alternately, the operator may choose to initiate the movement to specific map locations, via the "map movement" menu.

SETTING THE PROBE POSITIONS

The "clear", "zero", and "test" positions of the probes must be set.

To set these positions, the probe assembly should initially be at its "home" position i.e. fully up. If the probes are not "home", they should be put to their "home" position. The probes will go automatically to the "home" position upon entry to the "xyz" menu from another menu.

The "zero" position must be set before either of the other two probe positions are set. To set the zero position, the probes must first be brought down to a position where the probes are just touching the surface of the wafer..

IT IS VERY IMPORTANT THAT THE ZERO POSITION IS INDEED AT THE "JUST TOUCHING" POINT. IF NOT, THE PROBES MAY NOT BE BROUGHT UP FAR ENOUGH WHEN THEY GO TO THEIR "CLEAR" POSITION - WHICH WILL ALLOW THE PROBES TO SCRAPE THE WAFER AS IT IS MOVED!

If the "automatic goto just-touching" function is activated in software, and if the appropriate signal (active low at just-touching) is connected to the proper input pin, the probes may be brought down to their "just-touching" position automatically.

To bring the probes down to this "just-touching" position automatically, from wherever, the "goto just-touching" action key < TOUCHpos > is touched.

WARNING, IF THE "AUTOMATIC GO TO JUST-TOUCHING" FUNCTION IS ACTUATED, THE "JUST-TOUCHING" INPUT SIGNAL MUST BE CONNECTED AND MUST BE FUNCTIONAL-IF NOT, THE PROBE WILL CRASH INTO THE WAFER.

If the "automatic just-touching " function is NOT actuated, the probes must be brought down manually. To do this, the probes may first be brought down from their "home" position to a position close to the surface of the wafer. This movement is initialized with the probe <CLOSEpos> touch key. The "close" position of the probes is set initially to 500 steps below the probe "home" position. The "close" position of the probes may be changed by using the "setpoint" menu.

WARNING-TO USE THE "INITIAL" SETTING FOR THE CLOSE POSITION IT MUST BE ESTABLISHED THAT THE SURFACE OF THE WAFER IS GREATER THAN 500 STEPS FROM THE PROBES WHEN THEY ARE IN THEIR HOME (FULLY UP) POSITION. IF NOT, THEY WILL CRASH INTO THE WAFER WHEN THE "CLOSE " FUNCTION IS USED!

Once the probes are in the "close" position, they must be manually stepped down to the "just-touching" position using the <STEP-> key on the "XYZ MANUAL MOVE" menu. The probes are inhibited from being stepped below a "maximum-down" limit. This limit is set initially at 1,000 steps, but may be changed using the "setpoint" menu.

When the probes are in the "just-touching" position, they are, by definition, at the "zero" position. This position MUST be set by the operator.

Touching the "set zero" key will set the z-axis (probe) position coordinate number to "0". That is, all future indications of the actual probe position will be in reference to the "zero" position point. Positions of the probes up from the wafer surface will be indicated by a positive number of steps, whereas, positions of the probes below the "just-touching" position will be indicated by a negative number of steps.

Once the "zero" position on the probes is set, the "test" position must be set. The "test" position is that position of the probes where the probes are sufficiently lowered so that they are pressed onto the surface of the wafer with enough force so that reliable contact can be assured. To obtain this position, the probe contacts are watched on the video monitor, and if equipped to do so, electrical contact of the probes with the wafer surface is monitored.

Once the "test" position has been established, the <TESTpos> key should be touched. This will "set" the "test" position to the current probe position.

The operator will be prohibited from setting the 'test' position more than 50 steps below the 'zero' positiion of the probes.

The "clear" position should now be set. The "clear" position can be obtained by manually stepping the probes to the desired position.

Once a new "clear" position is obtained, it is "set" by touching the <setCLR> key. The minumum allowable 'clear' position value is 240 steps plus the maximum z-map depth (i.e. if the z-map is enabled).

The current values for the the two probe position setpoints, i.e. "clear" and "test" position, may be printed out by touching the <SET Z-POS> key followed by the <PRINT SP> key.

The current values for the two probe positions is retained as long as the power is not removed. If power is lost, the values for these two positions must be reset.

Z-MAP CONSIDERATIONS

There are a number of special considerations relating to the probe positions if the wafer has different elevations across its surface. These considerations are outlined in a separate description entiled "Z-Map Description". If the system has an enabled z-map, then this description should be read before proceeding on with the current document.

SETTING THE TP # 1 WAFER POSITION (note 1)

All test position coordinates contained in the maps are with respect to position #1 on the wafer (TP #1). However, the TP #1 location on the wafer is with respect to the wafer's "home" position. This "home" position is the "centered" position of the wafer, as determined by a set of micro-switches mounted on the x and y axes.

Therefore, to set the "TP #1 position", the wafer must first be brought to its "home position". The obtainment of this position will automatically "set" the "home position" - so that the xy coordinates of this position will both equal zero. Once the "home position" has been "set", the wafer may be moved to its "TP #1 position" - so that it too may be "set". To "set" the "TP #1 position", the <SET XY POS> key is touched, followed by the <SET TP #1> key.

note 1 : For some systems, the 'test position' designation is not appropriate. In these cases, the more general 'die,array' designation is used. A 'test position' corresponds to a particular 'die' position with no 'arrays' (sub-positions) within each die.

To actually move the wafer to the intended "TP #1 position", the <SLEW +>, <SLEW ->, <STEP +>, & <STEP -> keys are used on the "XYZ MANUAL MOVE" menu. The probes will have to be in their 'home' or their 'clear' position to allow xy movement.

Obtaining the default value for TP #1 position, by using the <GET SP> key, is equivalent to having previously moved to the default TP #1 position & having set" "TP #1" at that point.

Therefore, the wafer can be made to go to the approxiamate TP #1 position without having previously been there. Once in the appoxiamate TP #1 position, the wafer can be stepped and/or slewed to the exact position, at which point, the exact TP #1 position can be "set" by using the <SET TP #1> key.

The default "TP #1" position is not directly changable. It is based upon the wafer configuration data that exists in the map coordinate files. Whenever the map is changed, the map configuration parameters must be changed. The default "TP#1" position is based on these parameters, therefore it will change automatically.

THETA ADJUSTMENT

To adjust the angular, i.e. "theta", position of the stage, the operator must first put the stage in the "theta" position. To do this the operator touches the <THETA pos> key. The stage will then go automatically to the "theta position". The theta position is the extreme left position of the x-axis, with the y-axis at its home position.

It should be noted that the stage MUST be in the "home position" (at least with respect to the y-axis) before a movement to the theta position is allowed.

Once the stage is in the theta position, the wafer CANNOT be effectively rotated until the theta mechanism is engaged. This is accomplished by touching either the <+ENGAGE> or <-ENGAGE> keys. Touching one of these keys will cause the wafer to move in the + or -y axis direction (as selected) until the theta mechanism is in mechanical engagement. At this point, if the wafer is manually stepped in the y-axis direction (in the SAME direction in which the mechanism was engaged), a change in the rotational angle of the wafer (i.e. the "theta" angle) will be effected.

To rotate the wafer in the other direction, the "engagement" must be made in the opposite direction. After the wafer moves to the opposite engagement point, the operator may then adjust the theta angle in the other direction.

While the stage is in the "theta position" and "engaged", the total number of steps in either the + or - y axis direction is limited to a maximum of 1600. When the NET number of steps in either direction is about to exceed 1600, the operator is informed and any additional steps in the associated direction is inhibited.

After the stage has been rotated the appropriate amount, the stage may be brought out from the theta position by touching the <LV THETA> key. The stage will first move in the y-axis direction to the y-axis "home position" (i.e. y-position = 0). It will then travel in the x-axis direction to the "left limit" position. This is the normal left-most position of the stage in the x-axis. From this point the operator may choose to move the stage, as required, to establish whether additional 'theta' adjustment is necessary.

----------END----------

QUICK GUIDE, SETTING THE XYZ POSITIONS

This document is designed to guide a user through the steps required to set the 'zero', 'test', & 'clear' positions of the probe; and the 'die #1, array#1' (or 'test pos. #1') position of the wafer. It is assumed that the user is familiar with the system and its control through the use of the computer.

This procedure is especially useful for those systems that have the z-offset map enabled. It may, however, be used for those systems that do not have a z-map. In these cases, the probe positions do not have to be set at the 'die #1, array #1' ('test pos. #1') wafer position.

The example below assumes a system where there are no 'arrays' (sub-positions) on each die. As a result, the 'die' designation has been changed to the more appropriate 'test' position designation.

The user must first enter the "XYZ MANUAL MOVEMENT" menu before proceeding with this procedure. In addition, the system must be ready.

ACTION	KEY SEQUENCE	
1. Send probes to their 'home' position	<GOTO Z-POS>,	<HOME POS>
2. Send wafer to its 'home' position	<GOTO XY-POS>,	<HOME POS>
3. Get the wafer 'test pos. #1'	<SET XY-POS>,	<GET SP>
4. Goto the default wafer 'test pos. #1'	<GOTO XY-POS>,	<TP #1 POS>
5. Goto probe 'close' position	<GOTO Z-POS>,	<CLOSE>
6. Step probes until 'zero' pos. acheived	<STEP +-> keys	
7. Set <u>temporary</u> probe 'zero' position	<SET Z-POS>,	<SET ZERO>
8. Check probes with respect to wafer pads.	-	
9. Slew probes up to a <u>temporary</u> 'clear' pos.	<SLEW +> KEY	
10. Set <u>temporary</u> 'clear' position.	<SET Z-POS>	<SETCLR>
11. Step X & Y to achieve 'test pos. #1'	<STEP +-> KEYS	
12. Goto probe 'zero' position.	<GOTO Z-POS>	<ZERO>
13. Check probes with respect to wafer pads. If ok goto step #16, else continue.		
14. Goto probe 'clear' position.	<GOTO Z-POS>	<CLEAR>
15. Goto step #11.		
16. Set <u>final</u> 'test pos #1".	<SET XY POS>	<SETTP#1>
17. Step probes until <u>final</u> 'zero' pos.	<STEP ±> KEYS	
18. Set <u>final</u> probe 'zero' pos.	<SET Z-POS>	<SET ZERO>
19. Step probes until 'test' pos. acheived	<SETP +-> keys	
20. Set probe 'test' postion	<SET Z-POS>,	<SET TEST>
21. Goto '<u>temporary</u>'clear pos.	<GOTO Z-POS>,	<CLEAR>
22. Move probes until 'clear' pos. acheived	<STEP +-> &	<SLEW +-> keys
23. Set final probe 'clear' position	<SET Z-POS>,	<SET CLR>
25. Print setpoints (not required)	<SET Z-POS>,	<PRINT SP>
or	<SET XY-POS>,	<PRINT SP>

QUICK GUIDE, SETTING THE XYZ POSITIONS FOR SYSTEMS WITH A Z-MAP (cont'd.)

The probes are now at the 'clear' position, and the wafer is at the 'test pos. #1' position. All setpoints associated with the initial setting of the probe & wafer assemblies have been set.

At this point, the "XYZ MANUAL MOVEMENT" menu may be exited. The wafer may now be moved from 'test position' to 'test position' on the basis of the xy map. In addition, the probes may be moved to their 'test' and 'zero' positions, offset by the values in the z-map.

Z-MAP DESCRIPTION (Addendum to the XYZ MANUAL MOVEMENT menu description)

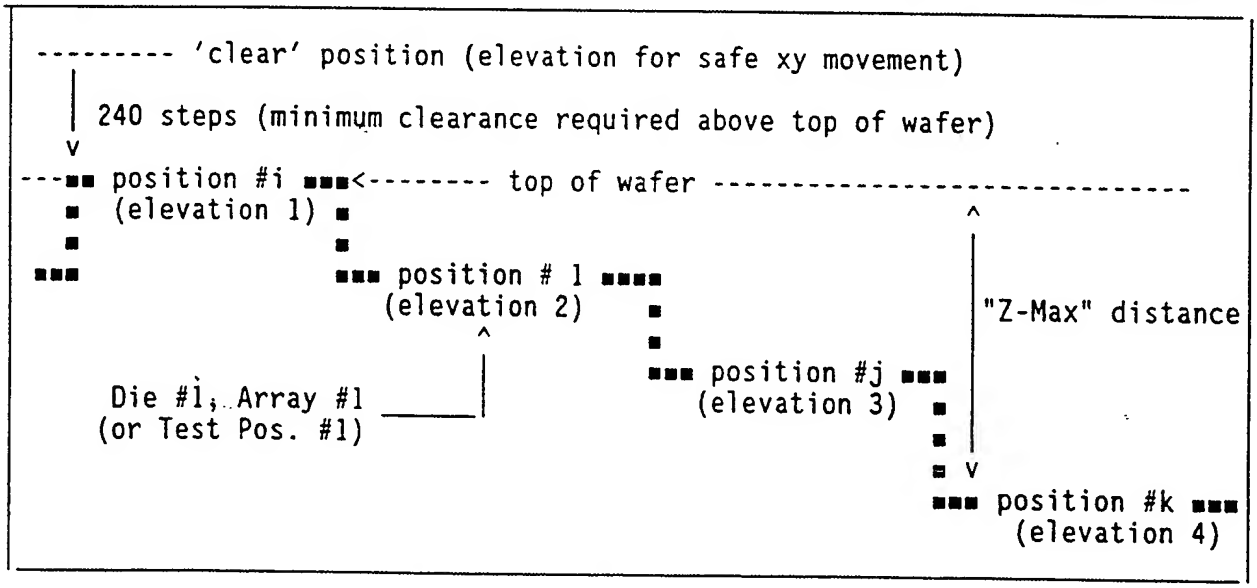
The AP-1 system may be used to probe a wafer which has "dies" (or "test" positions) that are at different z-axis elevations. (see note 1)

In this case, a "z-axis offset" map must be hand-enterd into the "z-map" file, "ZDIEMAP.00" and enabled by setting the "z-map" flag in the "software flags" file.

Systems that have a ""z-axis offset" map (z-map), have by necessity a FIXED die, array (or 'test' position) configuration. That is, the number of dies (or 'test' positions) in the x & y directions is fixed & cannot be changed in the setpoint menu. The step distance between each die, array, or 'test' position may still be changed however.

There are a number of special considerations involved in setting the z-axis 'clear', 'zero', & 'test' positions (and subsequently going to these positions) when there is a 'z-map" enabled.

To aid in the discussion, an example z-axis elevation diagram is shown below:



note 1: Wafers that have "arrays" (i.e. 'sub-positions' within each die) must have all "arrays" within each die at the same elevation.

Z-MAP DESCRIPTION (con't.)

The 'clear', 'zero', & 'test' positions can ONLY be set when the wafer is at the previously set 'die #1, array #1' (or 'test pos. #1') position.

While in the "XYZ MANUAL MOVEMENT" menu, z-axis movement to the 'zero' & test' positions can only be accomplished when the wafer is at the 'die #1, array #1' (or 'test pos. #1') position.

While in the "MAP MOVEMENT" menu or during "host control", z-axis movement to the 'zero' & 'test' positions is only allowed if the wafer is at a SPECIFIC xy map location.

The probe 'clear' position is prohibited from being set to a value less than (240 + 'Z-MAX') steps from the 'zero' position.

As can be seen in the example figure above, if the 'zero' position is set when the probes are over the xy position with the lowest elevation (#4), then as long as the minumum 'clear' position is (240 + 'Z-MAX') steps , there is no possibility for the probes to crash into the "walls" of the wafer wells as the wafer is moved - since no xy movement can occur if the probes are below the 'clear' level.

In summary, the 'die #1, array #1' (or 'test pos. #1') position may be set where desired, including the xy position with the lowest elevation. However, the probe 'clear', 'xero', & 'test' position must be set at this SAME xy position.

Direct movement to the preset 'test' & 'xero' positions can only be accomplished while the wafer is at the 'die #1, array #1' (or 'test pos. #1') position. However, movement to the 'clear' position is allowed whenever, regardless of the wafer xy position.

---------- end ----------

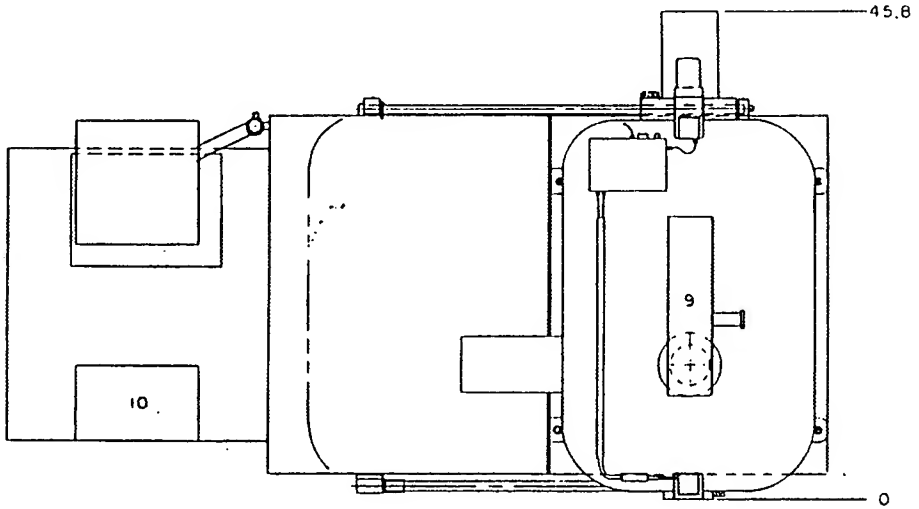
Notes

4

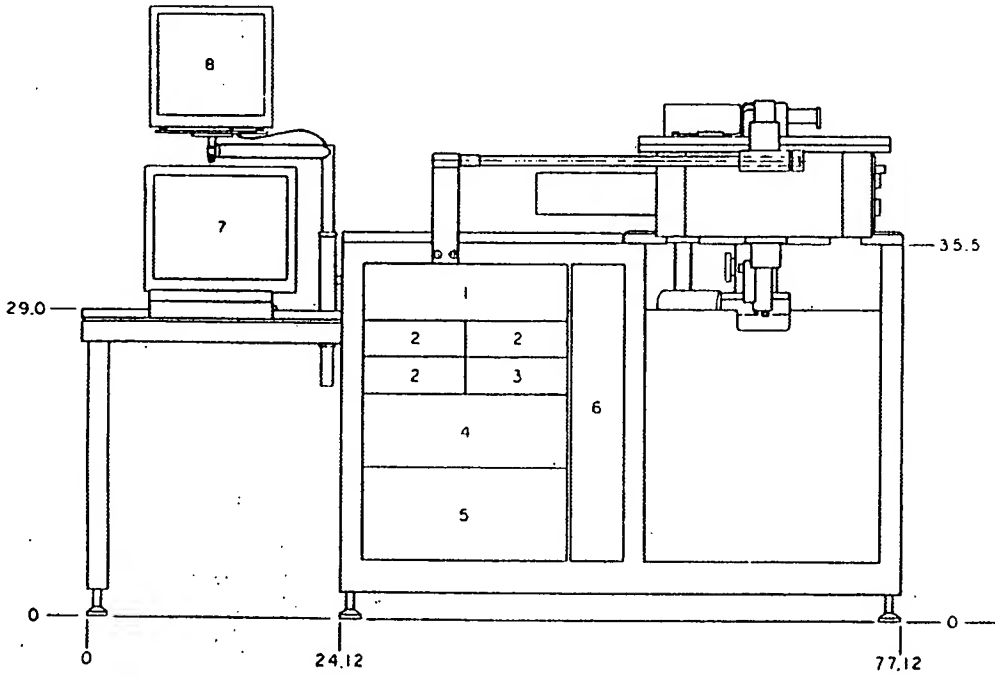
Pltf / Deft's EXHIBIT 583
for identification
Witness H. Appleby
Dated 5/13/98
Page 109 of 187 Pages
By Dolores Caloiaro CSR #9740

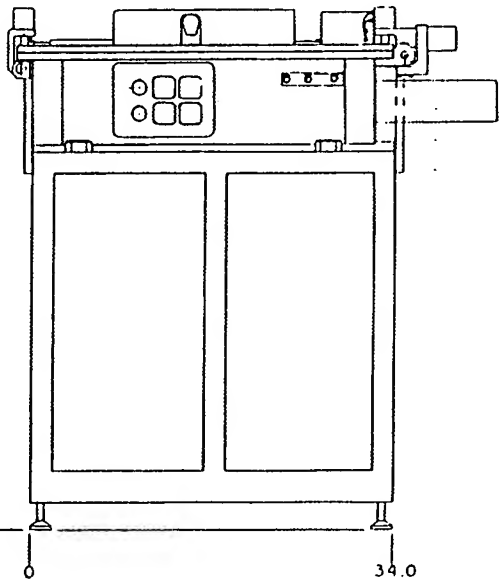
CRYOTEST STATION AP-4

FLEXON CORPORATION, SANTA BARBARA, CA



ITEM
1. BLANK USER
2. TEMPERATURE CONTROLLER
3. VACUUM GAUGE
4. COMPUTER
5. POWER SUPPLY
6. PRIMARY POWER PANEL
7. VIDEO MONITOR
8. TV MONITOR
9. VIEW OPTICS
10. MAIN CONTROL PANEL





Witness H. Bradley
Dated 5/13/98
Page 7 of 7 Pages
By Dolores Calderin

CSR #8740

Plaintiff's EXHIBIT 585
for Identification

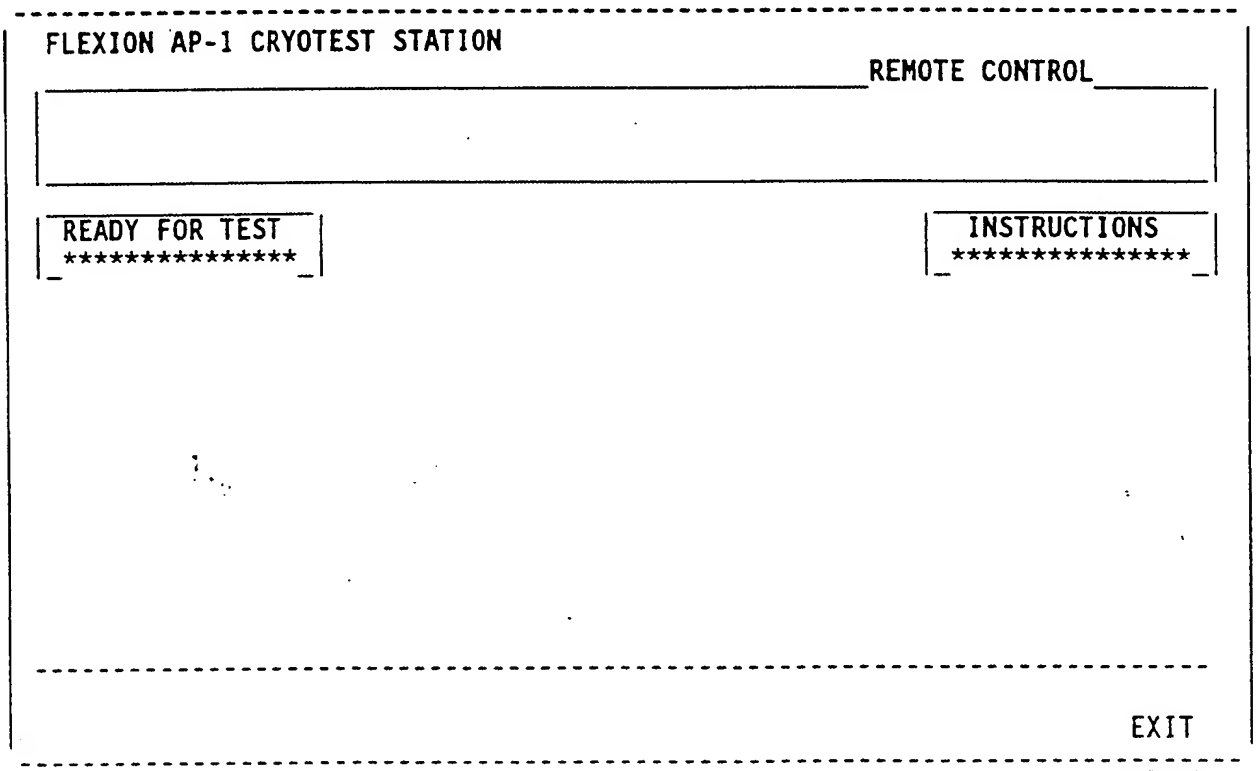
REMOTE MODE MENU DESCRIPTION

The operator enters the "remote mode" when it is desired that the host computer take control of the system.

Obtaining the "remote mode" menu is done by first touching the <REMOTE MODE> key on the "Main Menu" and then the <ENABLE> key. The display will change from the "main" menu selections to the "remote mode" selections. There are two choices availabe on the "remote mode" menu.

The <INSTRUCTIONS> choice allows the operator to review a check-list and a set of instructions pertaining to the setup of the system prior to entering the "host control" mode of operation. This list is presented on the following page.

The <READY FOR TEST> choice is used to initiate control of the system by the host computer.



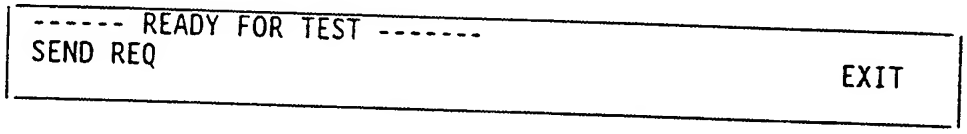
REMOTE MODE MENU DESCRIPTION (cont.)

The following is a list of the items that are checked by the HP150 before allowing an entry to the "remote control" mode:

(1) "Clear", "Zero", & "Test" positions of the probes have been set.
(2) "Home" & "Die #1, Array #1" (or "Test Pos. #1") positions of the wafer have been set.
(3) Temperature controllers #1 & #2 must both have sucessfully completed their "initialization" process.
(4) System must be at vacuum, as determined by BOTH the chamber TC & the atmosphere switches.

The above list of conditions is displayed on the crt screen when the <INSTRUCTIONS> key is touched.

When the <READY FOR TEST> key is touched, an "action choice" selection of <SEND REQ> or <EXIT> is presented to the operator at the bottom of the crt. Touching the <SEND REQ> key will send the "request for remote test mode" command to the host computer. Touching the <EXIT> key will return the operator to the "remote mode" menu selections again.



If the HP150 is indeed ready for host control, then from the point in time when the <SEND REQ> key is touched, the HP150 will wait for & respond to commands from the host computer. The HP150 is now in the "host control" mode.

If the host is also ready, it will acknowledge its condition back to the HP150. However, if the host is not ready, it will indicate this to the HP150. The HP150 will then exit the "host control" mode & return back to "local" control.

REMOTE MODE MENU DESCRIPTION (cont.)

If the HP150 receives no response from the host, within a present time, when it first enters the "host control" mode, the HP150 will automatically return to "local " control. The following figure shows the contents of the crt screen for this condition.

```
HP150 REMOTE MODE ACTIVE - WAITING FOR HOST ACKNOWLEDGEMENT

MESSAGE TO HOST: R10,1

NO ACTIVITY ON SERIAL LINE - 'TIMEOUT' ERROR !

RETURNING TO THE LOCAL MODE !
```

At any time, the operator may exit the "host control" mode by touching the <EXIT> key on the dislpay. An appropriate message will be sent to the host informing it that the HP150 is "unilaterally" leaving the "host control" mode and returning to "local" control.

While the HP150 is in the "host control" mode, the display will "log" all activity between it & the host (if enabled).

The exact content of each message will be shown on the display. Also shown will be the results of all host commands, and any data requested by the host.

In the event of an "abort" condition on the HP150, the exact nature of the condition is reported back to the host by sending the corresponding error number. If print-out is enabled (flag set in the "software flags file") and a serial printer is attached, all "abort" conditions will be printed.

----------END----------

COMMUNICATION SPECIFICATIONS, HP150 TO HOST COMPUTER

contents: page #:

I. COMMUNICATION SPECIFICATIONS - GENERAL SPECIFICATIONS

1. RS232C electrical standards
2. ASCII transmission code
3. Full-duplex, asynchronous
4. Direct connection
5. Transmit / receive speed: 9600 BAUD
6. Parity: NONE
7. Framing & overun checked
8. Data bits: 8
9. Stop bits: 1
10. HP150 buffer size: 256 bytes
11. Line-feed sent after carriage-return by HP150
12. No character echo by host
13. No character echo by HP150
14. Receive handshake - XON / XOFF or RTS/DTR
15. Transmitt handshake - XON / XOFF or CTS/DSR
16. Recognized Control Characters

<ACK>: Acknowledge, ASCII value = 6, CTRL-F

<NAK>: Negative acknowledge, ASCII value = 21, CTRL-U

<SOH>: Start of header, ASCII value = 1, CTRL-A

<RTN>: Carriage return, ASCII value = 13, CTRL-M

II. CRT MESSAGE ENABLE

All commands from the host and all responses from the HP150 are echoed on the crt screen until the "host-control" mode has been successfully entered. To increase the HP150's response time, all crt echoing is automatically disabled from this point in time. It may be re-enabled, or subsequently disabled, by touching the "crt-echo" toggle-key. Abort situations will always be echoed to the crt, regardless of the state of the "crt-echo" enable. The "crt-echo" will be automatically enabled upon exit from the host-control mode.

III. COMMUNICATION SPECIFICATIONS - MESSAGE FORMATS

1. General "command" format (from host)

<SOH> Cn , x, y <RTN>

n = command classification number, 0 to 99
x = parameter #1
y = parameter #2

2. General "error-status" format (to host)

<SOH> En , x <RTN>

n = command classification number, 0 to 99
x = error number, 0 to 99
(x = 0 if command not attempted)
(x = 1 if command successfully completed)
(x = 2 thru 99, other errors)

3. General "response" format (from HP150)

<SOH> Rn , x , y <RTN>

n = command classification number, 0 to 99
x = parameter #1
y = parameter #2

4. Message bracketing

<SOH>C, <SOH>E, <SOH>R identify the start of the message, while the end of the message is identified by the first occurance of <RTN> after the starting sequence.

5. Spaces

Spaces are not required in the message format. If spaces are included, they are ignored.

Messages to the host will typically have an extra space before each number. However, there will be no space between the <SOH> & the "R" or "E", as sent by the HP150.

IV. COMMUNICATION SPECIFICATIONS - GENERAL PROTOCOL

(See Appendix A: "Flow Charts & Remote Mode Protocol" for a Detailed Description)

1. A command message, in the "command" format, is sent to the HP150 from the host.

2. An <ACK> is sent back to the host if the command was received correctly (no framing or overrun errors) and understood (no syntax errors). Otherwise a <NAK> is sent back. This response by the HP150 will occur within 1 sec. after the receipt of the host command.

3. If a <NAK> is received by the host, the command should be sent again to the HP150. In general, a command may be repeatedly sent by the host to the HP150 as many times as desired.

4. After a successful command receipt, the HP150 will perform the required action, unless otherwise inhibited by software or the system.

5. The command result, either successfully completed, aborted, failed, inhibited, etc. is reported back to the host with the "error-status" message. The time of this response is a function of the nature of the command, and may be determined by consulting the "command response-time" table.

   A "response" message sent to the host instead of an "error status" message implies that the command was successfully completed.

6. The host acknowledges the error-status message from the HP150 with an <ACK>, or <NAK> if necessary, in which case, the message is sent again. This <NAK> may be sent, in general, as many times as necessary or desired.

7. Other messages and/or data sent to the host by the HP150, initiated either by the host, or the HP150 itself, are sent in the "response" format.

8. The host will also acknowledge the "response" message from the HP150 with an <ACK>, or <NAK> if necessary. The HP150 will repeat the "response" message each and every time it receives an <NAK> response from the host.

9. The HP150, after sending a message to the host, will expect, and wait for, a <ACK> or <NAK> in response within 1 min. of the transmission of its message. If no response by the host is received within this time, the HP150 will then automatically exit the "remote mode" & return to the "local mode".

V. COMMUNICATION SPECIFICATIONS - MESSAGE STRUCTURES

1. "SET STATE" command: C1,x,y

Host control of the state of specific output line(s) to the system, from the HP150 stepper motor board.

x = output # (0 to 15), y = state value (0 to 2)
(see "Output-Number Definition Table" for valid output #'s)

ex. set output #15 state : C1,15, y ('side' shutter)
y=0 : set 'side' shutter to "closed" position
y=1 : set 'side' shutter to "filter #1" position
y=2 : set 'side' shutter to "filter #2" position

1a. "SET STATE" response : E1,x

x=0 : command not attempted, i. e. inhibited, etc.
x=1 : command successfully completed
x=22 : command unsuccessfull, "feedback error" : output line has been set to the state requested, but the associated feedback input has not indicated the proper state within the alloted time.

2. "GET STATE" command : C2,x

Host obtainment of the condition of specific input line(s) from the system.

x = input # (0 to 15)
(see "Input Number Definition Table" for valid input #'s)

ex. get state of input #7 : C2,7
ex. get state of system (all inputs) : C2,0

2a. "GET STATE" error-status response : E2,x

x=0 : state not obtainable

2b. "GET STATE" data response : R2,x,y

x = input #(0 to 15), identical to value in corresponding "get state" command

y = state value (0 or 1)
(see "Input Number Definition" table for 'state' definitions)

ex. state = 0 on input #7 : R2,7,0
ex. state of system (S1 to S15) : R2,0,S1,S2,.....S15

V. COMMUNICATION SPECIFICATIONS - MESSAGE STRUCTURES con't.

3. "PROGRAM SETPOINT" command: C3,x,y

Host control of the values of various temperature controller setpoints, & other setpoints which may be defined.

x = setpoint # (1 to 24) (Note 3), y = setpoint value
ex. set setpoint #7 to value 15.75 : C3,7,15.75
(see "Setpoint Number Definition Table")

3a. "PROGRAM SETPOINT" response : E3,x

x=0 : setpoint not changed, write-protected
x=1 : setpoint changed
x>=2 : various errors see "Error Number Definition" Table

4. "GET SETPOINTS" command : C4, x

Host obtainment of the current value of the setpoint indicated
x = setpoint #(1 to 19) (see "Setpoint Number Definition" Table)
ex. C4,7 : get current value of setpoint #7 & send it to the host

4a. "GET SETPOINTS" error-status response : E4, x

x=0 : command not attempted, i.e. inhibited
x>=2 : various errors see "Error Number Definition" Table

4b. "GET SETPOINTS" data response : R4, x, y

x = setpoint number
y = current value of setpoint # x
(see "Setpoint Number Definition Table")

5. "GOTO PROBE POSITION" command : C8, x

Host control of the probe position, ie "clear", "zero", or "test" positions.

x = probe position (0 = "clear", 1 = "zero", 2 = "test")
ex. C8, 2 : goto "test" position

note: 'zero' & 'test' probe positions are automatically adjusted for z-axis offsets per the z-map, if so enabled in the 'setup' program

5a. "GOTO PROBE POSITION" response : E8, x

x=0 : command not attempted, ie inhibited
x=1 : command successfully completed
x>=2: command not completed successfully, (see table of errors)

V. COMMUNICATIONS SPECIFICATIONS - MESSAGE STRUCTURES con't.

6. "MODE-CONTROL" command : C10,x

Host command to the HP150 for a change in mode to that requested.

x = item #(0 or 1)
ex. goto "local" mode : C10,0 (see Protocol Appendix A)
ex. host ready for "remote" mode : C10,1 (see Protocol Appendix A)

6a. "MODE-CONTROL" error-status response : E10,x

x = 0 : command not performed ; x = 1 :command performed

6b. "MODE-CONTROL" messages by HP150 : R10,x

x = item # (0 or 1)

ex. statement of a unilateral, eminent return to the "local mode" by the HP150 : R10,0 (see Protocol Appendix A)
ex. statement of "remote" mode activated on the HP150 (i.e. ready for test) : R10,1 (see Protocol Appendix A)

7. "GOTO DIE & ARRAY POSITION" command : C11,d,r (note 5)

host control of the wafer position by commanding movement to a particular die # & array #, the specific position of which is dictated by the current die & array position maps . {note: array increments are in the "x" direction} This command automatically raises the probes to the "clear" position before xy movement. The probes are lowered to the "test" position after xy movement, if enabled with the appropriate "software flag".

d= die position # (1 to "last #"); r= array row # (1 to "last #")

ex. C11,0,0. : goto "home"(wafer centered) {special case of command}
ex. C11,1,1 : goto "die #1, array #1 {starting position}
ex. C11,43,38 : goto "die #43, array #38" position

note: if no "arrays" in the die, "r" MUST be equal to one (1).
note: "last #" is defined by virtue of defining the map coordinates.

note 5 : For some systems, the 'die, array' position designation is not appropriate. In these cases, the more general 'test position' designation is used - which corresponds to a particular 'die' position with no 'arrays' (sub-positions) within the die.

V. COMMUNICATION SPECIFICATIONS - MESSAGE STRUCTURES con't.

7. "GOTO DIE & ARRAY POSITION" response: E11,x

x=0 : command not attempted, ie inhibited
x=1 : command successfully completed
x>=2: command not completed successfully, (see "Table of Errors")

8. "GOTO RELATIVE WAFER POSITION" command : C12,x,y (note 5)

Host control of the wafer position by commanding movement to a particular x & y position relative to die #1, array #1 position (which is at x=0, y=0),as measured in number of steps. Die #1 is assumed to be at the top left-hand corner of the wafer & array #1 is assumed to be the left-most array row. This command automatically raises the probes to the "clear" position before xy movement. The probes are lowered to the "test" position after xy movement, if enabled with the appropriate "software flag".

x = "x-position" of wafer, relative to die#1, array#1 position (0 to x-max)
y = "y-position" of wafer, relative to die#1, array#1 position (0 to y-max)

ex. C12,0,0 : goto "die#1, array#1" position (starting position)
ex. C12, 1345, 16789 : goto x= 1345, y= 16789 position

note: x-max & y-max coorespond to the maximum steps allowed in the x & y directions, respectively. These max values are based upon the die coordinate data contained in the map files.

8a. "GOTO RELATIVE WAFER POSITION" response : E12,x

x=0 : command not attempted, ie inhibited
x=1 : command successfully completed
x>=2: command not completed successfully, (see "Table of Errors")

9. "GET RELATIVE WAFER POSITION" command : C19 (note 5)

Host obtainment of the present x,y coordinate of the wafer, relative to die #1, array #1 position, as measured in number of steps.

ex. C19 : obtain present x,y position of wafer, relative to die#1,array#1 position, & send data to host

note 5 : For some systems, the 'die, array' position designation is not appropriate. In these cases, the more general 'test position' designation is used - which corresponds to a particular 'die' position with no 'arrays' (sub-positions) within the die.

V. COMMUNICATION SPECIFICATIONS - MESSAGE STRUCTURES con't.

9a. "GET RELATIVE WAFER POSITION" error-response : E19, x

x = 0 : command not attempted, inhibited
x = 1 : command successfully completed
x>= 2 : command not completed successfully, (see "Table of Errors")

9b. "GET RELATIVE WAFER POSITION" data response : R19,x,y

x= "x-position" of wafer, relative to die #1, array#1 position
y= "y-position" of wafer, relative to die #1 position
ex. R19, 4445, 1002 : x position = 4445, y position = 1002

10. "GET TEMPERATURE" command : C20, n

Host obtainment of the actual temperature(s), as measured by the two temperature controllers.

n = temperature number (1= temp. cntrllr #1, sensor B ("shield")
(2= temp. cntrllr #1, sensor A ("probes") [control]
(3= temp. cntrllr #2, sensor B ("shutter")
(4= temp. cntrllr #2, sensor A ("wafer") [control]

10a. "GET TEMPERATURE" error-response : E20, x

x = 0 : command not attempted, inhibited
x = 1 : command successfully completed
x>= 2 : command not completed successfully (see "Table of Errors")

10b. "GET TEMPERATURE" data response : R20, n, x

n= temperature number, x= actual temperature in form xxx.xx
ex. R20,1,023.81 : 'shield' temp.= 23.81 K, cntrllr #1

(note: a response of " OR " will be sent, in place of a temp. value, in the case of an "overrange" indication on the temp. controller display)

(note: a wait of typically 2 seconds MUST be observed whenever the requested sensor is changed from A to B . The temperature controller needs this time to change its sensor channel).

note 5 : For some systems, the 'die, array' position designation is not appropriate. In these cases, the more general 'test position' designation is used - which corresponds to a particular 'die' position with no 'arrays' (sub-positions) within the die.

FLEXION CRYOTEST STATION, MODEL AP-1

VI. REFERENCE TABLES , con't.

INPUT NUMBER DEFINITION TABLE - for use with "get state" command

(0 = "not true" , 1 = "true")

INPUT #	NAME
0	system reference
1	shield heat switch (true at: "not at temp")
2	(reserved, not usable)
3	atmosphere switch (true at: "at atmos.")
4	foreline thermocouple setpoint (true at: pressure <= sp.)
5	chamber thermocouple setpoint (true at: pressure <= sp.)
6-11	(reserved, not usable)
12	side shutter feedback #2 (true at position)
13	side shutter feedback #1 (" " ")
14	top shutter feedback #2 (" " ")
15	top shutter feedback #1 (" " ") (or 'cold' shutter fb)

OUTPUT NUMBER DEFINITION TABLE - for use with "set state" command

(0,1 as indicated)

OUTPUT#	NAME
0	system reference
1	input group select (1=B group, 0=A group (default))(note 2)
2	backfill value (1=open/0=close) (note 2)
3	chamber lid down (1=on /0=off) (note 2)
4	chamber lid up (1=on /0=off) (note 2)
5	shield heaters (1=on /0=off) (note 2)
6	alarm (1=on /0=off) (if connected)
7	master enable (1=enable, 0=disable) (note 2)
8	spare
9	xy motor power control (1=full power, 0=standby power) (note 2)
10	spare
11	spare
12	view shutter (1=closed,"in" /0=open,"out")
13	top shutter (0=closed / 1=filter / 2=open) (only '0' and '2' valid for 'cold' shutter (ie. 2-pos. shutter)
14	spare
15	side shutter (0=closed / 1=filter #1 / 2=filter #2)

Note 2 : Those items indicated by this note are not controllable by the host in this version, & are shown for reference only.

VI. REFERENCE TABLES

SETPOINT NUMBER DEFINITION TABLE:

SETPOINT #	NAME	FORMAT (Note 4)	
1	temp. controller #1, "cold temp."	xxx.xx	
2	" , "gain" (proportional)	xx	(note 3)
3	" , "reset"(intergal)	xx	"
4,10,20,24	not used		
5	" , "power range,cool"	x	"
6	" , "power range,heat"	x	"
7	temp. controller #2, "cold temp."	xxx.xx	
8	" , "gain"	xx	(note 3)
9	" , "reset"	xx	"
11	" , "power range,cool"	x	"
12	" , "power range,heat"	x	"
13	access code	(never changeable by host)	
14	delta die increment (x-axis)	xxxx	(note 3)
15	delta die increment (y-axis)	xxxx	"
16	number of dies (x-axis)	xx	"
17	number of dies (y-axis)	xx	"
18	delta array increment (x-direction)	xxxx	"
19	number of arrays	xx	"
21	probe "minimum-clear" value	xxx	(note 3)
22	probe "close" position	xxx	"
23	probe "max-down" position	xxxx	"

COMMAND RESPONSE-TIME TABLE:

For use in determining the time between a particular command and the HP150's response back to the host , indicating the results of the command action. This time includes the time required to respond back with an <ACK>.

COMMAND NUMBER & NAME	MAXIMUM RESPONSE TIME
1. set state	1 second
2. get state	1 second
3. program setpoints	1 second
8. goto probe position	1 second
10. mode control	1 second
11. goto die#, array# position	# steps/800 + 1 second
12. goto relative wafer position	# steps/800 + 1 second
19. get relative wafer position	1 second
20. get actual temperature	1 second

note 3 : those setpoints indicated by this note are not changeable by the host in this version, & are shown for reference only.
note 4 : The format indicated above must be strictly observed.

VI. REFERENCE TABLES con't.

ERROR NUMBER DEFINITION TABLE (note 5)

ERROR #	DEFINITION
0	Command not attempted, inhibited by system
1	Command completed successfully
2	Command not implemented
3	Coordinate check failure
4	Failed x axis starting condition check
5	Failed y axis starting condition check
6	Invalid die or array number
7	Cannot start x motion
8	Cannot start y motion
9	Timeout during x y movement
10	Motion aborted, x axis limit switch actuated
11	Motion aborted, y axis switch actuated
12	Cannot obtain x position
13	Cannot obtain y position
14	Final x position not correct
15	Final y position not correct
16	Failed z axis starting condition check
17	Cannot start z motion
18	Timeout during z motion
19	Motion aborted, z axis limit switch actuated
20	Cannot obtain z position
21	Final z position not correct
22	feedback input does not agree with output state within alloted time
23	Setpoint not changed, value out of range or invalid
24	Temperature controller #1 access error
25	Temperature controller #2 access error
26	Temperature controller #1 setpoint readback error
27	Temperature controller #2 setpoint readback error
28	System not at vacuum
29	Shutter not implemented
30	No disk in drive #2
31	Disk is full
32	Disk is write protected
33	Cannot find file on disk
34	Miscellaneous disk error
35	Command not performed, communication test active
36	Miscellaneous parameter value error

END

COMMAND EXAMPLES (note 1)

1. OPENING SCREEN

successful entry into remote mode

```
DIE MAP ID #1: 890, ID #2: 895 ; ARRAY MAP ID #: 89.5

HP150 REMOTE MODE ACTIVE - WAITING FOR HOST ACKNOWLEDGEMENT

MESSAGE TO HOST: R10,1
<ACK>

<SOH>C10,1

COMMAND: (OK), 'ACK' TRANSMITTED

HOST IS READY FOR THE REMOTE MODE

MESSAGE TO HOST : E10,1
```

Unsucessful entry into remote mode

```
DIE MAP ID #1: 890, ID #2: 895 ; ARRAY MAP ID #: 89.5

HP150 REMOTE MODE ACTIVE - WAITING FOR HOST ACKNOWLEDGEMENT

MESSAGE TO HOST: R10,1
<ACK>

<SOH>C10,0  <-------------------------------------------------<<<<<

COMMAND: (OK), 'ACK' TRANSMITTED

HOST IS NOT READY FOR THE REMOTE MODE - GOING BACK TO LOCAL MODE

MESSAGE TO HOST : E10,1
```


note 1: For some systems, the 'die, array' position designation is not appropriate. In these cases, the more general 'test position' designation is used. A 'test' position corresponds to a particular 'die' position with no 'arrays'(sub-positions) within the die.

2. COMMAND 1, "SET STATE"

set 'view' shutter state

```
<SOH>C1,12,0

COMMAND: (OK), 'ACK' TRANSMITTED

SET OUTPUT STATE COMMAND - IN PROCESS

VIEW SHUTTER = OUT

MESSAGE TO HOST: E1, 1
<ACK>
```

set 'side shutter' state (abort condition shown)

```
<SOH>C1, 15, 1

COMMAND: (OK), 'ACK' TRANSMITTED

SET OUTPUT STATE COMMAND - IN PROCESS

SIDE SHUTTER: FILTER #1 POSITION
TIMEOUT, FEEDBACK ABORT !

MESSAGE TO HOST : E1, 22
<ACK>
```

set state of invalid output

```
<SOH>C1, 16, 1

COMMAND: (NG), '<NAK>' TRANSMITTED
```

3. COMMAND 2, "GET STATE"

get state of input #1 (shield heaters)

```
<SOH> C2, 1

COMMAND : (OK) , 'ACK' TRANSMITTED

GET INPUT STATE COMMAND - IN PROCESS

STATE OF INPUT #1 : 1

MESSAGE TO HOST: R2, 1, 1
<ACK>
```

get state of all inputs

```
<SOH> C2; 0

COMMAND : (OK) , 'ACK' TRANSMITTED

GET INPUT STATE COMMAND - IN PROCESS

STATE OF INPUT PORTS OBTAINED

MESSAGE TO HOST: R2, 0, 1, 1, 0, 1, 1, 0, 1, 1, 1, 0, 1, 1, 0, 1, 1
<ACK>
```

4. COMMAND 3, "PROGRAM SETPOINT"

change temperature setpoint in controller #2

```
<SOH>C3, 7, 123.40

COMMAND: (OK), 'ACK' TRANSMITTED

PROGRAM SETPOINT COMMAND - IN PROCESS

TEMPERATURE SETPOINT CHANGED TO : 123.40

MESSAGE TO HOST: E3. 1
<ACK>
```

attempt to change setpoint #4

```
<SOH>C3, 4, 123.90

COMMAND: (OK), 'ACK' TRANSMITTED

PROGRAM SETPOINT COMMAND - IN PROCESS

COMMAND NOT IMPLEMENTED IN THIS VERSION !

MESSAGE TO HOST: E3. 2
<ACK>
```

5. COMMAND 4, "GET SETPOINTS"

get temperature setpoint from controller #2 (setpoint #7)

```
<SOH>C4, 7

COMMAND : (OK), 'ACK' TRANSMITTED

GET CURRENT SETPOINTS COMMAND - IN PROCESS

CONTROLLER #2, TEMPERATURE SETPOINT = 123.40

MESSAGE TO HOST: R4, 7, 123.40
<ACK>
```

6. COMMAND 5, "SELECT SETPOINTS" (command not implemented)
7. COMMAND 6, "SAVE SETPOINTS" (command not implemented)
8. COMMAND 7, spare command #
9. COMMAND 9, spare command #

10. COMMAND 8, "GOTO PROBE POSITION"

goto 'clear' position

```
<SOH>C8, 0

COMMAND:  (OK), 'ACK' TRANSMITTED

GOTO PROBE POSITION  - IN PROCESS

PROBES AT 'CLR-POSITION' : 240

MESSAGE TO HOST: E8, 1
<ACK>
```

goto 'zero' position

```
<SOH>C8, 1

COMMAND:  (OK), 'ACK' TRANSMITTED

GOTO PROBE POSITION  - IN PROCESS

PROBES AT ZERO-POSITION

MESSAGE TO HOST: E8, 1
<ACK>
```

goto 'test' position

```
<SOH>C8, 2

COMMAND:  (OK), 'ACK' TRANSMITTED

GOTO PROBE POSITION  - IN PROCESS

PROBES AT TEST-POSITION : -23

MESSAGE TO HOST: E8, 1
<ACK>
```

11. COMMAND 10, "MODE-CONTROL"

host command indicating its readiness for system control

```
<SOH>C10, 1

COMMAND:  (OK), 'ACK' TRANSMITTED

MODE CONTROL COMMAND - IN PROCESS

MESSAGE TO HOST : E10, 0
<ACK>
```

host command releasing its system control

```
<SOH>C10, 0

COMMAND:  (OK), 'ACK' TRANSMITTED

MODE CONTROL COMMAND - IN PROCESS

HOST TERMINATION OF REMOTE MODE

MESSAGE TO HOST : E10, 1
<ACK>
```

12. COMMAND 11, "GOTO DIE & ARRAY POSITION" (note 1)

goto 'home' position

```
<SOH>C11, 0, 0

COMMAND:  (OK), 'ACK' TRANSMITTED

GOTO DIE, ARRAY POSITION COMMAND - IN PROCESS

PROBES AT 'CLR-POSITION' :240

MOVEMENT COMPLETED, WAFER AT X POS.=4450, Y POS. =4475

MESSAGE TO HOST :E11, 1
<ACK>
```

_____goto 'die #9, array #2' position

```
<SOH>C11, 9, 2

COMMAND:  (OK), 'ACK' TRANSMITTED

GOTO DIE, ARRAY POSITION COMMAND - IN PROCESS

PROBES AT 'CLR-POSITION' :240

MOVEMENT COMPLETED, WAFER AT DIE # 9, ARRAY #2

MESSAGE TO HOST :E11, 1
<ACK>
```

_____goto 'die #2, array #10' position (abort situation)

```
<SOH>C11, 2, 10

COMMAND:  (OK), 'ACK' TRANSMITTED

GOTO DIE, ARRAY POSITION COMMAND - IN PROCESS

CANNOT GOTO DIE #2, ARRAY #10, X-AXIS MOTION INHIBITED

STARTING CONDITION SHOULD BE: ED(hex), NOT 2D(hex)

MESSAGE TO HOST :E11, 4
<ACK>
```

13. COMMAND 12, "GOTO RELATIVE WAFER POSITION"

_____goto x=4500, y=50 steps from 'die #1, array #1' position

```
<SOH>C12, 4500, 50

COMMAND: (OK), 'ACK' TRANSMITTED

GOTO X,Y POSITION COMMAND - IN PROCESS

PROBES AT 'CLR-POSITION': 240

MOVEMENT COMPLETED, WAFER AT X POS. = 4500, Y POS. = 50

MESSAGE TO HOST: E12,1
<ACK>
```

14. COMMAND 13, "PROGRAM/SAVE DIE POSITION MAP" (command not implemented)

15. COMMAND 14, "PROGRAM/SAVE ARRAY POSITION MAP" (command not implemented)

16. COMMAND 15, "SELECT DIE-POSITION MAP" (command not implemented)

17. COMMAND 16, "SELECT ARRAY-POSITION MAP" (command not implemented)

18. COMMAND 17, "GET DIE-POSITION MAP" (command not implemented)

19. COMMAND 18, "GET ARRAY-POSITION MAP" (command not implemented)

20. COMMAND 19, "GET RELATIVE WAFER POSITION"

get xy position relative to 'die #1, array #1' position

<SOH>C19

COMMAND: (OK), 'ACK' TRANSMITTED

GET X, Y POSITION COMMAND - IN PROCESS

RELATIVE POSITION : X-POS. = 4449, Y-POS. = 4764

MESSAGE TO HOST : R19, 4449, 4764
<ACK>

21. COMMAND 20, "GET TEMPERATURE"

get temperature #3 from controller #2 (sensor B)

<SOH>C20,3

COMMAND: (OK) , 'ACK' TRANSMITTED

GET TEMPERATURE COMMAND - IN PROCESS

ACTUAL TEMP. #3 = 021.24

MESSAGE TO HOST: R20, 3, 021.24
<ACK>

COMMUNICATION SPECIFICATIONS, APPENDIX A: PROTOCOL: "REMOTE MODE"

The HP150 enters the remote mode when the operator touches the "ready for test" key. This assumes the conditions are appropriate, otherwise the software will disable the entry to the remote mode.

The HP150, when entering the remote mode, sends the "R10,1" message to the host, indicating its new condition. The protocol associated with the sending of this message, and all messages, to the host is outlined in the section entitled " HP150 Message Protocol: HP150 to Host".

After sending the "HP150 remote mode activated" message to the host, the HP150 will wait until it receives a command from the host or an instruction from the HP150 operator to return to the local mode.

The HP150 may be returned to the local mode by the operator touching the "exit" key. This action will cause the HP150 to send the "R10,0" message to the host, which indicates that the HP150 is unilaterally returning to the local mode.

Whenever a command is received, it is analyzed for various syntax and parameter value errors. If the command is in error a "NAK" character is sent back to the host, otherwise an "ACK" is sent back.

Before the HP150 will perform any other various commands, it must receive a command from the host affirming the host's readiness for the remote mode. If the host is ready, it sends the "C10,1" message to the HP150. If the host is not ready, the "C10,0" message is sent. This latter command causes the HP150 to go back to the local mode.

Receipt of either "C10,1" or "C10,0" commands will cause the "E10,1" response message to be sent to the host, which indicates the successful completion of the host command.

If the host has indicated its readiness for the remote mode, the HP150 will then process all commands that it receives from the host.

As each command is received, and if the command is not in error, the HP150 will perform the requested action. At the completion of the action, the HP150 will indicate the results of the command by sending one of three message forms back to the host.

If the action was compeleted successfully, the "Ex,1" message is sent to the host, where x is equal to the command number.

PROTOCOL: "REMOTE MODE" (cont.)

If the action was not completed successfully, the "Ex,y" message is sent to the host, where x is equal to the command number and y is equal to the error number.

If the command required the sending of data back to the host, the "Rx,A,B,C..." message is sent back-where x is equal to the command number, and A,B,C, etc is equal to the data.

If the command received by the HP150 is "C10,0", i.e. "go to local mode", the HP150 will acknowledge this command with the "E10,1" message sent to the host (i.e. command completed successfully); and then will proceed to automatically exit the remote mode and return to the local mode.

HP150 MESSAGE PROTOCOL: HP150 TO HOST

(Refer To Associated Flow Chart)

After a message is sent to the host, the HP150 will wait for an "ACK" or "NAK" control character in response to its message.

If the HP150 does not receive either of these two characters within one minute, the HP150 will send the "R10,0" message to the host-which indicates a "unilateral" return to the local mode by the HP150.

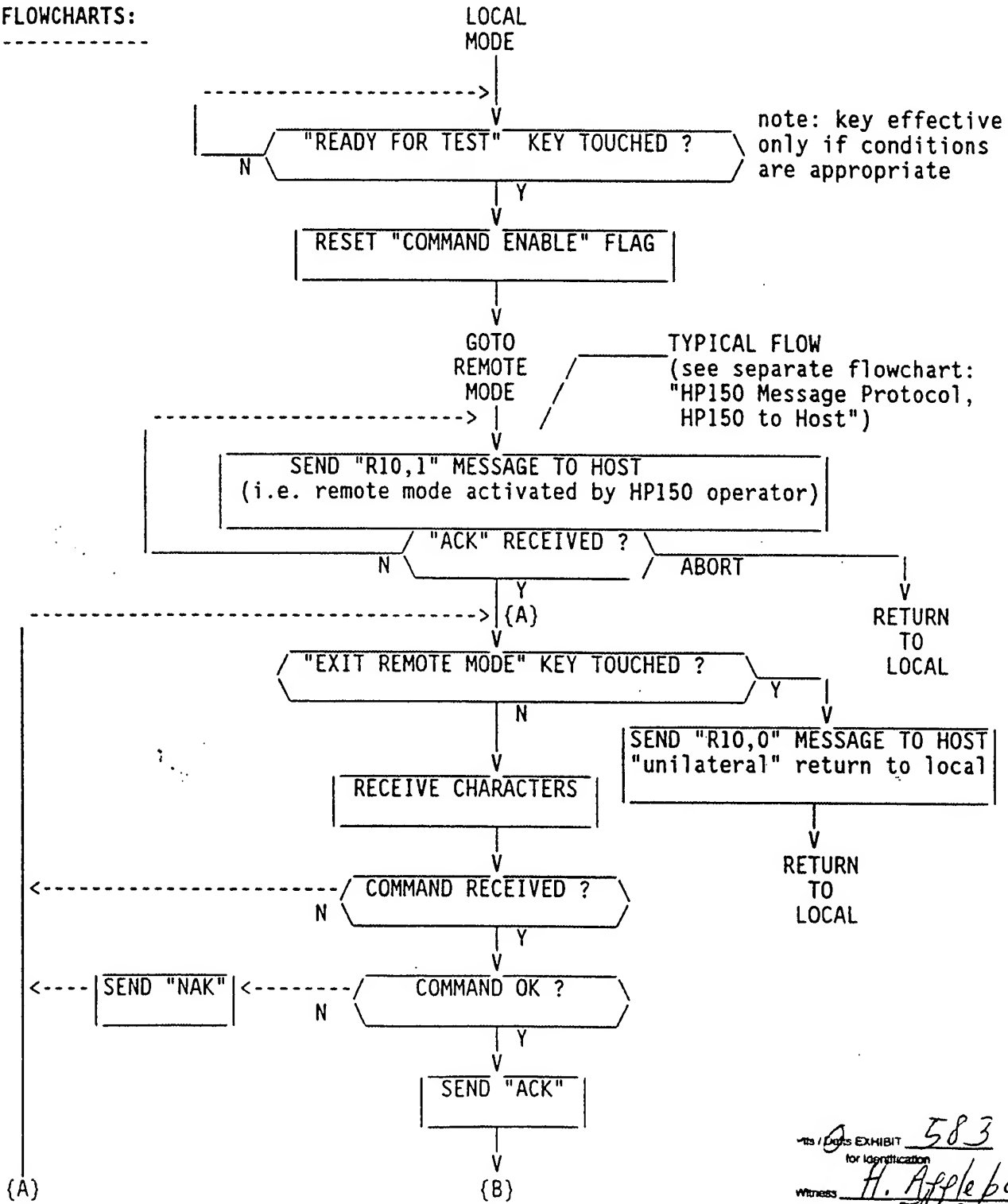
Once in the "local" mode, the HP150 will not recognize, or respond to, any characters sent to it by the host.

If a "NAK" character is received by the HP150, the previous message will be sent again to the host and the HP150 will again wait for an "ACK" or "NAK" character. This cycle will be repeated for a total of only three times under certain circumstances, otherwise the cycle will be repeated 10 times. The cycle repeats only three times whenever the HP150 operator first activates the remote mode on the HP150.

If while waiting for an "ACK" or "NAK" character from the host, the HP150 operator touches the "exit" key, then the HP150 will send the "R10,0" message to the host and unilaterally exit the remote mode.

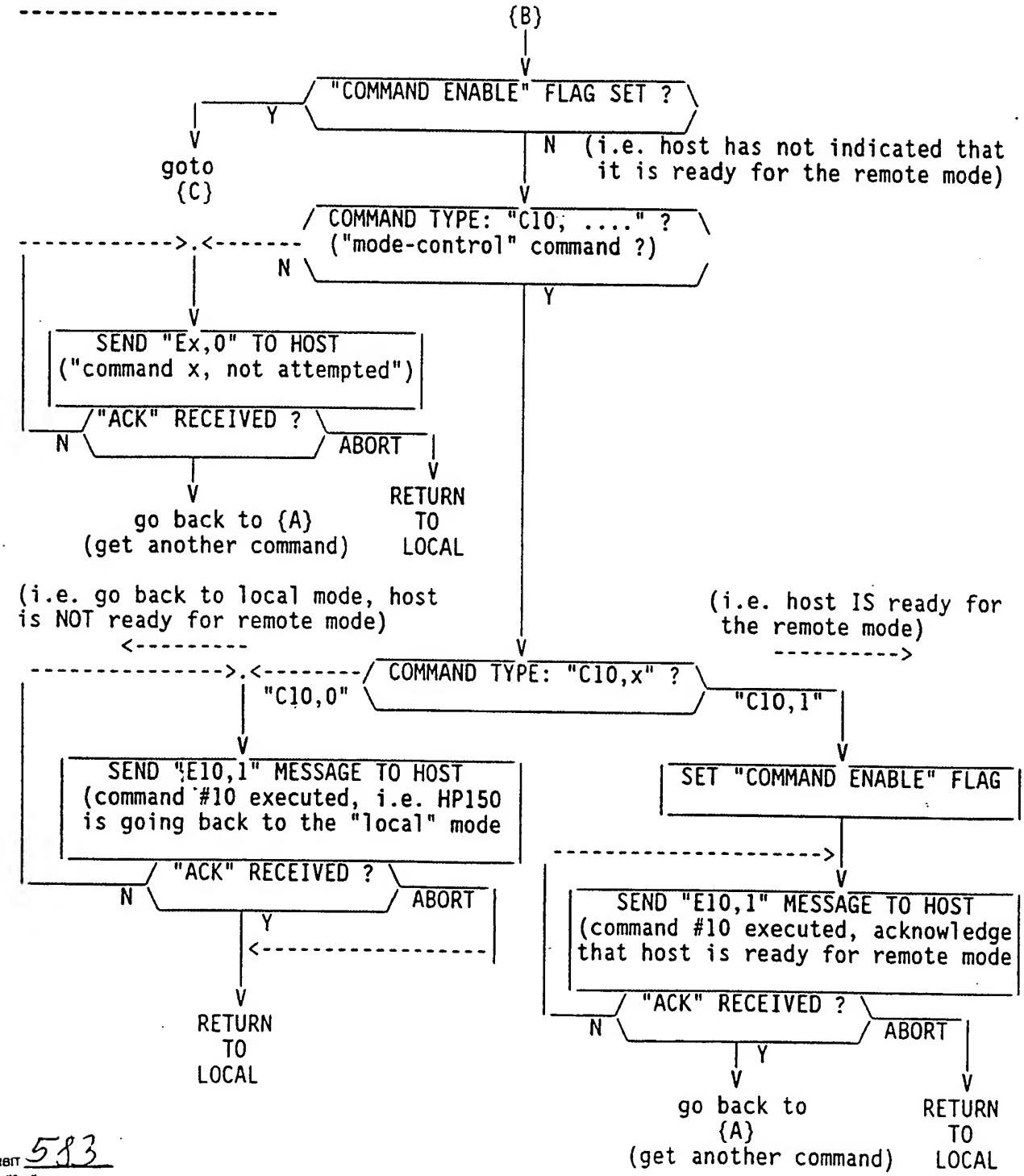
APPENDIX A: PROTOCOL: "REMOTE MODE" (See Descriptions)

FLOWCHARTS:



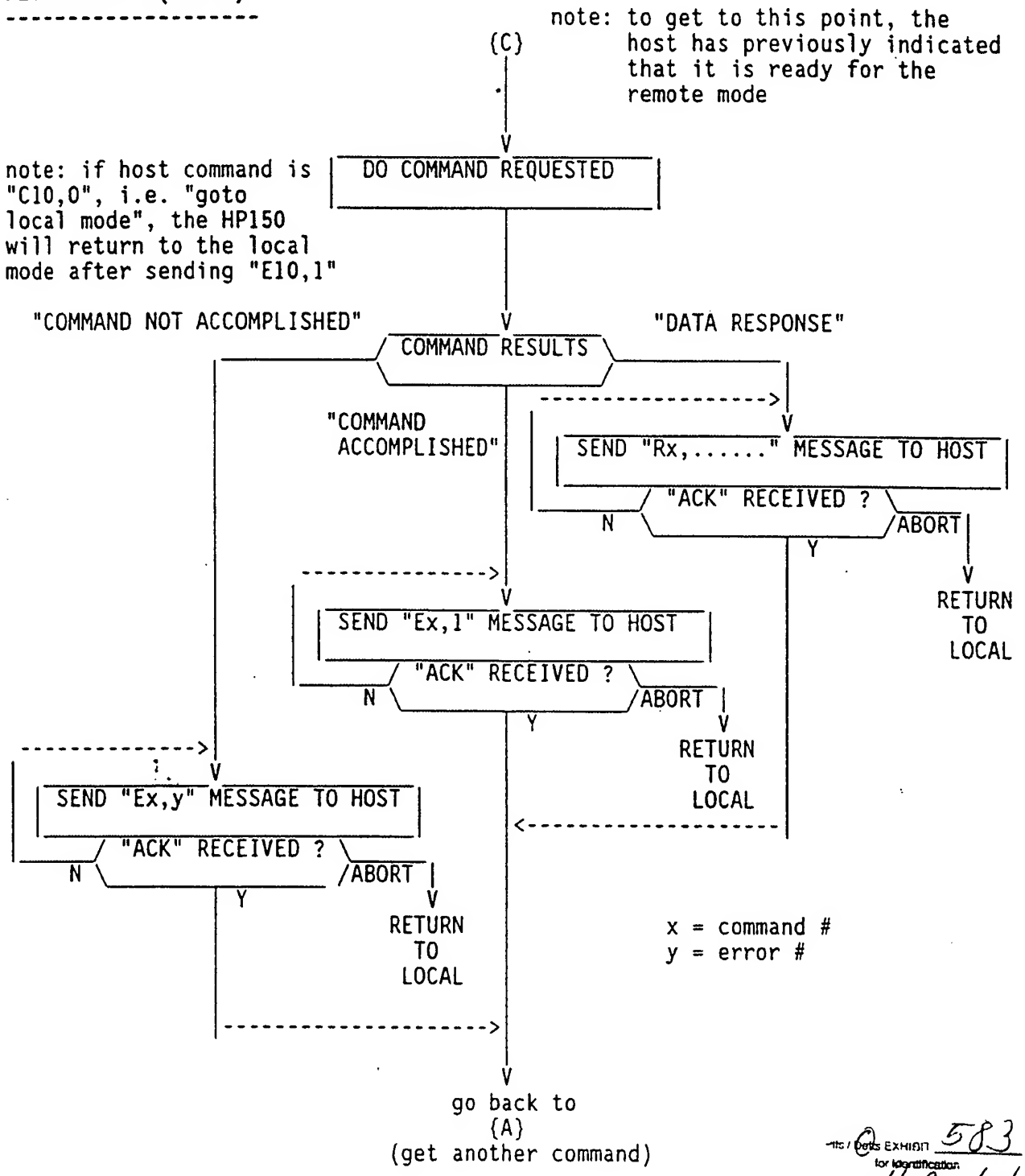
APPENDIX A: PROTOCOL: "REMOTE MODE"

FLOWCHARTS: (cont.)

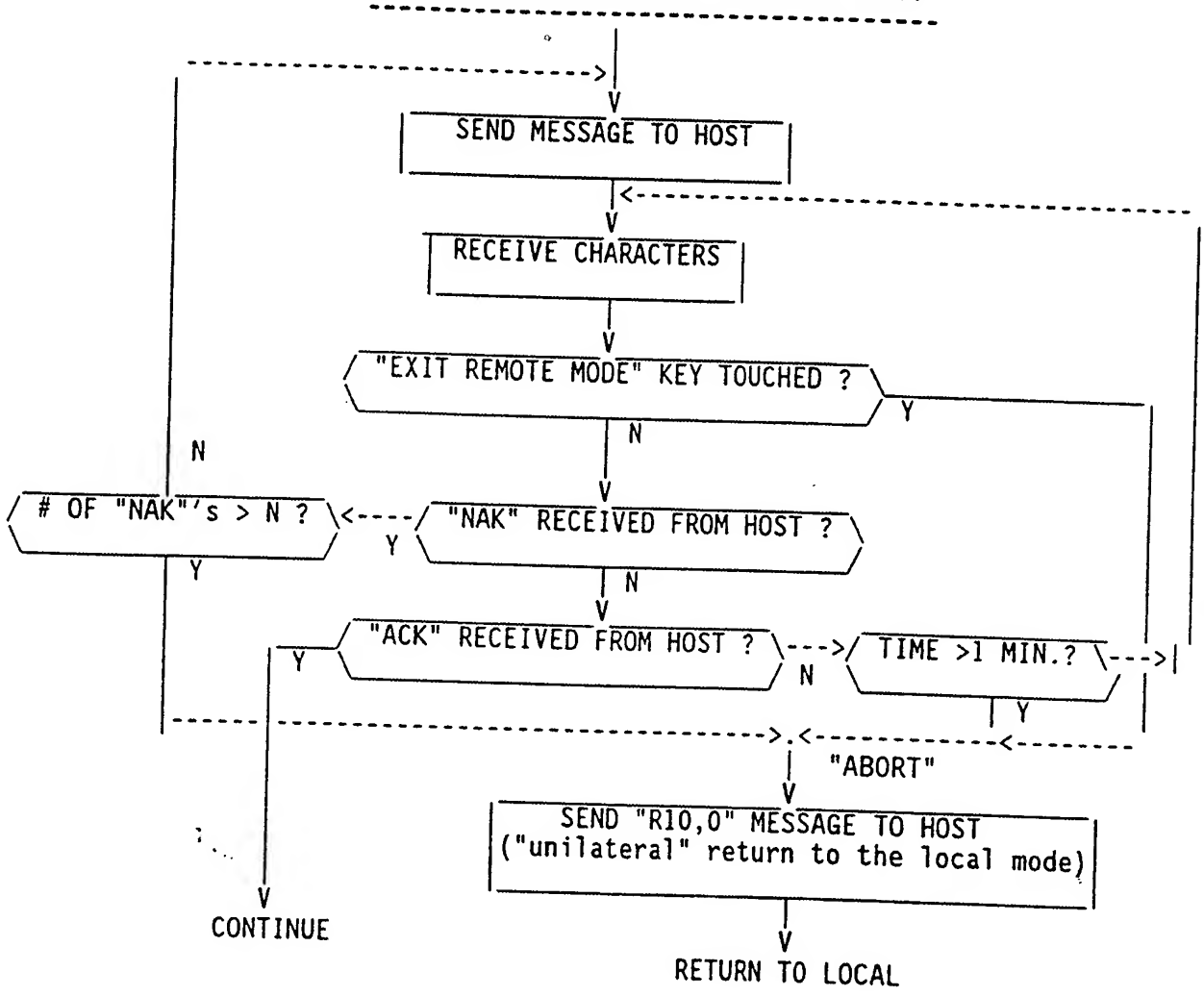


APPENDIX A: PROTOCOL: "REMOTE MODE"

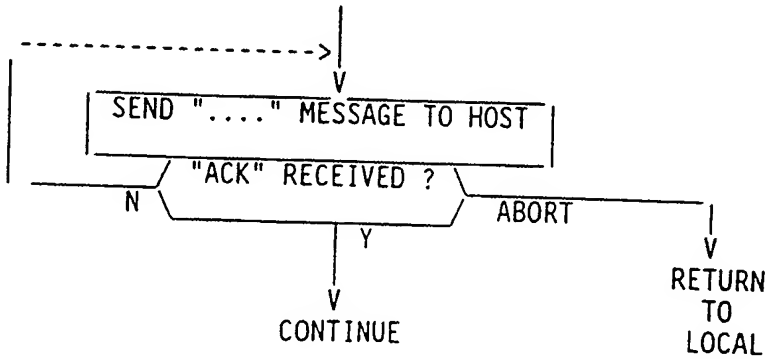
FLOWCHARTS: (cont.)



HP150 MESSAGE PROTOCOL, HP150 TO HOST



SYMBOL:



==========

FLEXION CORPORATION, MODEL AP-1 CRYOTEST STATION

==========

NOTES ON THE "HOST SIMULATION" ('HOSTSIMA.EXE') PROGRAM

1. The 'source code' ("Hostsima.bas") for this program has been extensively documented. It is intended that this code be used as an example of the requirements upon the host computer, with respect to the 'host-control mode' and the associated 'software protocol'. The program may also be used to 'test' the 'basic' functions of serial control - prior to implementing the full 'host-control' program.

2. The 'Hostsima.exe' program is designed to run on an IBM PC/XT/AT or compatible computer. It is designed to interface with the host computer using a standard serial RS232C connection to the COM2 port on the HP150.

3. The detailed serial setup for both the host computer and the HP150 computer, including the communication protocol and 'handshake' requirements, is described in the 'Host Communication Specifications' document - which is contained in the AP-1 manual.

4. This program supports the following host-control functions, which are selected via a screen menu on the host computer:

a) "Send Wafer and Probes to 'Home' Pos."
b) "Wafer Test Using XY Maps"
c) "Wafer Test Using Die/Array Designations"
d) "View System Temperatures, including Change of the 'Cold' Temp. Setpoint"
e) "View System Status"
f) "Set Shutter Positions".

5. The xy map data (for use with the 'Wafer Test Using Xy Maps" function) is the 'standard' 'test' map. That is, 4 x-dies by 12 y-dies, with dimensions indicated in the map files contained on this disc.

6. The 'die/array' configuration (for use with the "Wafer Test Using Die/Array Designations") is 4 x-dies by 12 y-dies by 65 arrays per die. Dimensions are contained in map files in the AP-1 system.

7. The 'Hostsima.bas' 'ASCII' (text) source file, which is written in Microsoft QuickBasic 4.0, may be printed out by typing "TYPE Hostsima.bas".

hostsima.doc 6/02/88

```
'
'  Flexion Corperation                                   PH#: (805)/965-0860
'  427 N. Nopal Street  Santa Barbara, CA 93103
'
'  Host Simulation Program       Copyright 1988 by Flexion Corporation
'
'  "HOSTSIMA.BAS"          DATE: 5/31/88                 Revision: A
'
'  Programming Environment: Microsoft QuickBASIC 4.0
'  Runtime Program: HOSTSIMA.EXE        Programmer: Roy P. Eltham
'                                                   Rainbow Enterprises
'
' This program is an example of host control of the AP-1 system by Flexion.
' It was designed using an IBM clone as the host, and hooks up to the
' AP-1 system via a serial communication line to the HP-150.  The program
' uses the protocol defined in the AP-1 manual for host control to send
' commands and recieve responses.
' The options supported are:
'       1. Send Wafer and Probe to "home" position
'       2. Wafer test using xp maps
'       3. Wafer test using die/array designations
'       4. View System Temperatures and allow changing of the cold setpoints
'       5. View the System Status
'       6. Set Shutter Positions
' In addition the the options above, there is a manual mode that allows the
' user to manually enter commands and see the responses.

DEFINT A-Z

'These are declarations of QuickBASIC SUB-programs.  They are the sections of
'code that are separate programs in themselves that are CALLed by the main
'module and also by other SUB-programs.  They are similar to subroutines, but
'are more versatile because they have local variables and can be recursive.
DECLARE SUB HandShake ()
DECLARE SUB WaitKey (ak$)
DECLARE SUB GetResponse (n)
DECLARE SUB SendCommand (Cmd$)
DECLARE SUB GetMaps (filename$, array(), n)

MaxPos = 100   'maximum number of posible xy positions
DIM Xpos(MaxPos), Ypos(MaxPos)

'SHARED variables means the same as global variables
DIM SHARED ACK AS STRING, NAK AS STRING, SOH AS STRING, flag AS INTEGER
DIM SHARED SystemError(36)  AS STRING, Response(20) AS STRING
DIM SystemStatus(15, 0 TO 1) AS STRING, t$(6)

'Fill SystemError Array with error strings
GOSUB SetErrorArray

NAK = CHR$(21)    'Negative AcKnowledge
ACK = CHR$(6)     'ACKnowledge
SOH = CHR$(13) + CHR$(10) + CHR$(10) + CHR$(1)   'Start Of Header
```

```
'open communication line with system
OPEN "com1:9600,n,8,1,bin,cs,ds" FOR RANDOM AS #1

'display title & wait for keypress
CLS
LOCATE 10, 1
PRINT "                    ZDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDD?"
PRINT "                    3      Host Control Simulation      3"
PRINT "                    3                                   3"
PRINT "                    3  Copyright 1988 by FLEXION Corp.  3"
PRINT "                    3                                   3"
PRINT "                    3    Revision: A   Date: 5/31/88    3"
PRINT "                    3                                   3"
PRINT "                    3     Press any key to continue.    3"
PRINT "                    @DDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDY"

CALL WaitKey(ak$)
Start:
flag = 0
CLS
CALL HandShake  'do initial handshake with system

menu:
CLS
PRINT STRING$(80, "-")
COLOR 15, 0  : PRINT "          HOST CONTROL SIMULATION ";
COLOR 7, 0   : PRINT " Copyright 1988 by FLEXION Corporation "
PRINT STRING$(80, "-")
LOCATE 10, 20
PRINT TAB(20); "1. Manual System Control "
PRINT TAB(20); "2. Send Wafer & Probe To 'Home' Positions "
PRINT TAB(20); "3. Wafer Test (Using XY Maps) "
PRINT TAB(20); "4. Wafer Test (Using Die/Array Designations) "
PRINT TAB(20); "5. System Temperatures "
PRINT TAB(20); "6. View System Status "
PRINT TAB(20); "7. Set Shutter Positions "
PRINT TAB(20); "8. Exit Host Control "
PRINT
COLOR 31, 0 : PRINT TAB(20); "Enter Choice:";
COLOR 7, 0

MenuLoop:
CALL WaitKey(ak$)
IF flag = 2 THEN GOTO Start    'Restart if system returns to local control
IF ak$ < "1" OR ak$ > "8" THEN GOTO MenuLoop
PRINT ak$
Choice = VAL(ak$)
flag = 0
ON Choice GOSUB ManualSysControl, SendEmHome, WaferTestXY, WaferTestDA, SystemT
emp, ViewSystemStatus, SetShutterPositions, ExitHC
IF flag = 2 THEN GOTO Start    'Restart if system returns to local control
GOTO menu
```

```
'This subroutine is for manually sending commands to the system.
'It gets the Response and displays it.

ManualSysControl:
    CLS
    PRINT "Now in Manual System Control..."
    LOCATE 24, 1 : PRINT "Q - Exit Manual System Constrol ";
    C$ = ""
GetCommand:
    LOCATE 2, 1 : PRINT "Command to send: "; C$;
    COLOR 31, 0: PRINT "* "; SPACE$(60): COLOR 7, 0
    CALL WaitKey(ak$)
    ak$ = UCASE$(ak$)     'convert ak$ to uppercase
    IF ak$ = "Q" THEN GOTO ExitManual
 'make sure first character typed is a 'C'
    IF LEN(C$) = 0 AND ak$ <> "C" THEN GOTO GetCommand
    IF flag = 2 THEN RETURN   'Restart if system returns to local control
    IF ak$ = CHR$(13) THEN GOTO DoCommand
 'handle backspace and backarrow keys
    IF (ak$ = CHR$(0) + CHR$(75) OR ak$ = CHR$(8)) AND LEN(C$) > 1 THEN
        C$ = LEFT$(C$, LEN(C$) - 1)
        GOTO GetCommand
    END IF
    IF (ak$ = CHR$(0) + CHR$(75) OR ak$ = CHR$(8)) AND LEN(C$) = 1 THEN
        C$ = ""
        GOTO GetCommand
    END IF
 'ignore all other special keys
    IF LEFT$(ak$, 1) = CHR$(0) THEN GOTO GetCommand
 'ignore control characters
    IF ASC(ak$) < 28 THEN GOTO GetCommand
    C$ = C$ + ak$
    GOTO GetCommand
DoCommand:
    LOCATE 4, 1: PRINT SPACE$(79)
    C$ = RTRIM$(LTRIM$(C$))      'Trim off leading and trailing spaces
    LOCATE 4, 1
    PRINT "Sending Command...      "
    CALL SendCommand(C$)
    IF flag = 2 THEN RETURN      'Restart if system returns to local control
    IF flag = 3 THEN
        C$ = ""                  'handle bad command
        flag = 0
        a$ = INPUT$(LOC(1), #1)
        GOTO GetCommand
    END IF
    LOCATE 4, 1
    PRINT "Waiting For Response... "
    CALL GetResponse(n)
    IF n = -1 THEN               'handle timeout
        LOCATE 4, 1
        PRINT "Timeout!                "
        GOTO GetCommand
    END IF
```

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for identification
Witness H. Applebay
Dated 5/13/98
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```
    'display systems Response or Error to command
       LOCATE 4, 1
       PRINT "RESPONSE:";
       FOR x = 1 TO n - 1: PRINT Response(x); ","; : NEXT x
       PRINT Response(n); SPACE$(48)
       C$ = ""
       GOTO GetCommand
ExitManual:
       LOCATE 24, 1
       PRINT SPACE$(79);
RETURN

' This subroutine send the "send wafer and probe home" command and waits for
' the response.

SendEmHome:
       CLS
       PRINT " Sending Wafer and Probe Home... "
       CALL SendCommand("C11, 0, 0")
       IF flag = 2 THEN RETURN     'Restart if system returns to local control
       CALL GetResponse(n)
       IF n = -1 THEN              'handle timeout
          LOCATE 4, 1
          PRINT "Timeout!"
       END IF
RETURN

' This routine first take the x y position data, in the map files, and sends
' it to the system using the GOTO XY position command.
' it also puts the probes in TEST position after every move.

WaferTestXY:
       xmap$ = "xdiemap.00"    'default x y map filenames
       ymap$ = "ydiemap.00"
       CLS
       PRINT "The default x map filename is '"; xmap$; "' OK (Y/N)?"
       CALL WaitKey(ak$)
       ak$ = UCASE$(ak$)   'convert ak$ to uppercase
       IF flag = 2 THEN RETURN
       IF ak$ = "Y" OR ak$ = CHR$(13) THEN GOTO GetYName
       IF ak$ <> "N" THEN GOTO WaferTestXY
       INPUT "Enter Filename: "; xmap$
       IF xmap$ = "" THEN GOTO WaferTestXY
GetYName:
       PRINT "The default y map filename is '"; ymap$; "' OK (Y/N)?"
       CALL WaitKey(ak$)
       ak$ = UCASE$(ak$)   'convert ak$ to uppercase
       IF flag = 2 THEN RETURN
       IF ak$ = "Y" OR ak$ = CHR$(13) THEN GOTO DoTest
       IF ak$ <> "N" THEN GOTO GetYName
       INPUT "Enter Filename: "; ymap$
       IF xmap$ = "" THEN GOTO GetYName
```

```
'This subroutine is for manually sending commands to the system.
'It gets the Response and displays it.

ManualSysControl:
    CLS
    PRINT "Now in Manual System Control..."
    LOCATE 24, 1 : PRINT "Q - Exit Manual System Constrol ";
    C$ = ""
GetCommand:
    LOCATE 2, 1 : PRINT "Command to send: "; C$;
    COLOR 31, 0: PRINT "* "; SPACE$(60): COLOR 7, 0
    CALL WaitKey(ak$)
    ak$ = UCASE$(ak$)     'convert ak$ to uppercase
    IF ak$ = "Q" THEN GOTO ExitManual
 'make sure first character typed is a 'C'
    IF LEN(C$) = 0 AND ak$ <> "C" THEN GOTO GetCommand
    IF flag = 2 THEN RETURN   'Restart if system returns to local control
    IF ak$ = CHR$(13) THEN GOTO DoCommand
 'handle backspace and backarrow keys
    IF (ak$ = CHR$(0) + CHR$(75) OR ak$ = CHR$(8)) AND LEN(C$) > 1 THEN
        C$ = LEFT$(C$, LEN(C$) - 1)
        GOTO GetCommand
    END IF
    IF (ak$ = CHR$(0) + CHR$(75) OR ak$ = CHR$(8)) AND LEN(C$) = 1 THEN
        C$ = ""
        GOTO GetCommand
    END IF
 'ignore all other special keys
    IF LEFT$(ak$, 1) = CHR$(0) THEN GOTO GetCommand
 'ignore control characters
    IF ASC(ak$) < 28 THEN GOTO GetCommand
    C$ = C$ + ak$
    GOTO GetCommand
DoCommand:
    LOCATE 4, 1: PRINT SPACE$(79)
    C$ = RTRIM$(LTRIM$(C$))      'Trim off leading and trailing spaces
    LOCATE 4, 1
    PRINT "Sending Command...      "
    CALL SendCommand(C$)
    IF flag = 2 THEN RETURN      'Restart if system returns to local control
    IF flag = 3 THEN
        C$ = ""                  'handle bad command
        flag = 0
        a$ = INPUT$(LOC(1), #1)
        GOTO GetCommand
    END IF
    LOCATE 4, 1
    PRINT "Waiting For Response... "
    CALL GetResponse(n)
    IF n = -1 THEN               'handle timeout
        LOCATE 4, 1
        PRINT "Timeout!                "
        GOTO GetCommand
    END IF
```

```
'display systems Response or Error to command
    LOCATE 4, 1
    PRINT "RESPONSE:";
    FOR x = 1 TO n - 1: PRINT Response(x); ","; : NEXT x
    PRINT Response(n); SPACE$(48)
    C$ = ""
    GOTO GetCommand
ExitManual:
    LOCATE 24, 1
    PRINT SPACE$(79);
RETURN

' This subroutine send the "send wafer and probe home" command and waits for
' the response.

SendEmHome:
    CLS
    PRINT " Sending Wafer and Probe Home... "
    CALL SendCommand("C11, 0, 0")
    IF flag = 2 THEN RETURN    'Restart if system returns to local control
    CALL GetResponse(n)
    IF n = -1 THEN             'handle timeout
        LOCATE 4, 1
        PRINT "Timeout!"
    END IF
RETURN

' This routine first take the x y position data, in the map files, and sends
' it to the system using the GOTO XY position command.
' it also puts the probes in TEST position after every move.

WaferTestXY:
    xmap$ = "xdiemap.00"   'default x y map filenames
    ymap$ = "ydiemap.00"
    CLS
    PRINT "The default x map filename is '"; xmap$; "' OK (Y/N)?"
    CALL WaitKey(ak$)
    ak$ = UCASE$(ak$)   'convert ak$ to uppercase
    IF flag = 2 THEN RETURN
    IF ak$ = "Y" OR ak$ = CHR$(13) THEN GOTO GetYName
    IF ak$ <> "N" THEN GOTO WaferTestXY
    INPUT "Enter Filename: "; xmap$
    IF xmap$ = "" THEN GOTO WaferTestXY
GetYName:
    PRINT "The default y map filename is '"; ymap$; "' OK (Y/N)?"
    CALL WaitKey(ak$)
    ak$ = UCASE$(ak$)   'convert ak$ to uppercase
    IF flag = 2 THEN RETURN
    IF ak$ = "Y" OR ak$ = CHR$(13) THEN GOTO DoTest
    IF ak$ <> "N" THEN GOTO GetYName
    INPUT "Enter Filename: "; ymap$
    IF xmap$ = "" THEN GOTO GetYName
```

```
DoTest:
    CLS
    PRINT "Getting x y maps..."
    CALL GetMaps(xmap$, Xpos(), n)    'get x map file into array
    CALL GetMaps(ymap$, Ypos(), n)    ' "  y  "   "    "     "
    NumberOfPos = n
    CLS
    PRINT "Testing...  XmapID# ="; Xpos(0); "  YmapID# ="; Ypos(0)
    LOCATE 24, 1
    PRINT " ESC - Cancel and return to menu ";
    FOR i = 1 TO NumberOfPos
        LOCATE 3, 1
        PRINT "Going to Position:  X ="; Xpos(i); "  Y ="; Ypos(i); "          "
        C$ = "C12," + STR$(Xpos(i)) + "," + STR$(Ypos(i))
        CALL SendCommand(C$)          ' send command to move to xy position
            IF flag = 2 THEN RETURN
        LOCATE 3, 55
        PRINT "Probe at 'CLR Position' "
        CALL GetResponse(n)
            IF n = -1 THEN LOCATE 4, 1: PRINT "Timeout!"
        ak$ = INKEY$
        IF ak$ = CHR$(27) THEN EXIT FOR
        CALL SendCommand("C8, 2")   'command to send probes to test position
            IF flag = 2 THEN RETURN
        CALL GetResponse(n)
            IF n = -1 THEN LOCATE 4, 1: PRINT "Timeout!"
        LOCATE 3, 55
        PRINT "Probe at 'TEST Position'"
        ak$ = INKEY$
        IF ak$ = CHR$(27) THEN EXIT FOR
    NEXT i
    LOCATE 24, 1
    PRINT SPACE$(79);
RETURN

' This routine Cycles through the Die/Array Designation numbers using the
' GOTO Die/Array Position command.
' (The Probe goes to test position automatically.)

WaferTestDA:
 'get number of dies from user
    Dies = 48
    Arrays = 65
    CLS
    PRINT "The default number of dies is '"; Dies; "' OK (Y/N)?"
    CALL WaitKey(ak$)
    ak$ = UCASE$(ak$)
    IF flag = 2 THEN RETURN
    IF ak$ = "Y" OR ak$ = CHR$(13) THEN GOTO GetArray
    IF ak$ <> "N" THEN GOTO WaferTestDA
    INPUT "Enter number of Dies: "; Dies
    IF Dies = 0 THEN GOTO WaferTestDA
```

```
GetArray:
 'get number of arrays from user
    PRINT "The default # of Arrays is '"; Arrays; "' OK (Y/N)?"
    CALL WaitKey(ak$)
    ak$ = UCASE$(ak$)
    IF flag = 2 THEN RETURN
    IF ak$ = "Y" OR ak$ = CHR$(13) THEN GOTO DoTest1
    IF ak$ <> "N" THEN GOTO GetArray
    INPUT "Enter # of Arrays: "; Arrays
    IF Arrays = 0 THEN Arrays = 1
DoTest1:
    CLS
    PRINT "Testing...     "
    LOCATE 24, 1
    PRINT " ESC - Cancel and return to menu ";
    FOR D = 1 TO Dies
        FOR R = 1 TO Arrays
            LOCATE 3, 1
            PRINT "Going to Die:"; D; "   Array:"; R; "     "
            C$ = "C11," + STR$(D) + "," + STR$(R)
            CALL SendCommand(C$)    'send command to move to Die/Array pos.
            IF flag = 2 THEN RETURN 'restart if system returns to local control
            CALL GetResponse(n)
            IF n = -1 THEN     ' handle timeout
                LOCATE 4, 1
                PRINT "Timeout!"
            END IF
        'see if user hit ESC key and exit if so
            ak$ = INKEY$
            IF ak$ = CHR$(27) THEN EXIT FOR
        NEXT R
        IF ak$ = CHR$(27) THEN EXIT FOR
    NEXT D
    LOCATE 24, 1
    PRINT SPACE$(79);
RETURN

' This routine reads the systems temperatures and allows setting of the
' cold temperature setpoints.

SystemTemp:
    CLS
    PRINT "Reading the system temperatures... "
    LOCATE 23, 48
    PRINT "ESC - Cancel and return to menu"
    FOR i = 1 TO 4
        IF i < 3 THEN
            LOCATE 4, 1
            PRINT "Reading Temperature Controller #1"
        ELSE
            LOCATE 4, 1
            PRINT "Reading Temperature Controller #2"
        END IF
```

```
' Reading the temperatures requires sending the "read temperature" command
' twice, if the temperature being read is from a different sensor than the
' previous temperature read. (i.e. if you just read sensor A and want to read
' sensor B it will require sending the command twice.)  The first time is to
' tell the system you want to read a temperature from different sensor.
' The system will return 999.99 for the tempurature.  Then the
' host must wait for two seconds and send the command again.  This time the
' system will respond with the correct temperature.  The following loop
' handles reading all the temperatures.

        FOR j = 1 TO 2
            CALL SendCommand("C20," + STR$(i))
            IF flag = 2 THEN RETURN
            CALL GetResponse(n)
            IF n = -1 THEN LOCATE 4, 1 : PRINT "Timeout! "
            a$ = INKEY$: IF a$ = CHR$(27) THEN RETURN  'exit if user hits ESC
            IF j = 1 THEN    'if this is the first time around then
                st! = TIMER  ' do 2 sec. delay
waittemp:
                IF TIMER - st! < 2 THEN GOTO waittemp
            END IF
        NEXT j
        IF LEFT$(Response(1), 1) = "R" THEN 'is the response data?
            t$(i) = Response(3)             'yes then put it in t$(i)
        ELSE t$(i) = "Error!"               'no
        END IF
    NEXT i
ReReadSets:
    CLS
    PRINT "Reading Setpoints..."
    LOCATE 23, 48 : PRINT "ESC - Cancel and return to menu"
    CALL SendCommand("C4,1")           'read cold setpoint #1
    IF flag = 2 THEN RETURN
    CALL GetResponse(n)
    IF n = -1 THEN LOCATE 4, 1 : PRINT "Timeout! "
    a$ = INKEY$: IF a$ = CHR$(27) THEN RETURN  'exit if user hit ESC
    IF LEFT$(Response(1), 1) = "R" THEN
        t$(5) = Response(3)
    ELSE t$(5) = "Error!"
    END IF
    CALL SendCommand("C4,7")           'read cold setpoint #2
    IF flag = 2 THEN RETURN
    CALL GetResponse(n)
    IF n = -1 THEN LOCATE 4, 1 : PRINT "Timeout! "
    a$ = INKEY$: IF a$ = CHR$(27) THEN RETURN
    IF LEFT$(Response(1), 1) = "R" THEN
        t$(6) = Response(3)
    ELSE t$(6) = "Error!"
    END IF
```

```
'display temperatures and setpoints
    CLS
    LOCATE 23, 48
    PRINT "ESC - Cancel and return to menu"
    LOCATE 8, 1
    PRINT "Temp. Controller #1, Cold Setpoint (K)    : "; t$(5)
    PRINT "Temp. Controller #1, Sensor A ('Probes')  : "; t$(2)
    PRINT "Temp. Controller #1, Sensor B ('Shield')  : "; t$(1)
    PRINT
    PRINT "Temp. Controller #2, Cold Setpoint (K)    : "; t$(6)
    PRINT "Temp. Controller #2, Sensor A ('Wafer')   : "; t$(4)
    PRINT "Temp. Controller #2, Sensor B ('Shutter') : "; t$(3)
    PRINT
    PRINT "Would you like to change the cold setpoints (Y/N)?";
ChangeYN:
    CALL WaitKey(ak$)
    IF flag = 2 THEN RETURN
    IF ak$ = CHR$(27) THEN RETURN
    ak$ = UCASE$(ak$)
    IF ak$ = "Y" OR ak$ = CHR$(13) THEN GOTO ChangeSetpoints
    IF ak$ = "N" THEN GOTO LeaveTempSet ELSE GOTO ChangeYN
ChangeSetpoints:
    PRINT
    PRINT "Enter controller # to change (1/2)?";
GetControllerNumber:
    CALL WaitKey(ak$)
    IF flag = 2 THEN RETURN
    IF ak$ = CHR$(27) THEN RETURN
    ak = VAL(ak$)
    IF ak > 2 OR ak < 1 THEN GOTO GetControllerNumber
    PRINT ak$
    IF ak = 2 THEN ak = 7  'the command to change setpoint #2 is c3,7,V
GetValue:                  'so we need to change the 2 to a 7
    LOCATE 20, 1
    PRINT SPACE$(79)  'clear line 20
    LOCATE 20, 1
    INPUT "New setpoint value (XXX.XX):"; a$
    Value! = VAL(a$)
    Value! = INT(Value! * 100) / 100    'truncate value to 2 decimal places
    V$ = STR$(Value!)
    CALL SendCommand("C3," + STR$(ak) + "," + V$)
    IF flag = 2 THEN RETURN
    IF flag = 3 THEN
        flag = 0       'handle bad command (i.e. user enter bad value)
        LOCATE 6, 1
        PRINT SPACE$(79)
        GOTO GetValue
    END IF
    LOCATE 4, 1
    PRINT SPACE$(79)
    CALL GetResponse(n)
    IF n = -1 THEN LOCATE 4, 1 : PRINT "Timeout! "
    GOTO ReReadSets
```

```
LeaveTempSet:
    LOCATE 23, 1
    PRINT " Press a key to return to menu "; SPACE$(48)
    CALL WaitKey(ak$)
RETURN

' This routine reads the system status and parses the 1's and 0's into
' meaningful strings.

ViewSystemStatus:
    CLS
    PRINT "Reading System Status..."
    CALL SendCommand("C2,0")      'send command to read all status indicators
    IF flag = 2 THEN RETURN
    CALL GetResponse(n)
    IF n = -1 THEN
        LOCATE 4, 1
        PRINT "Timeout! "
    END IF
    CLS
    LOCATE 5, 1
    PRINT "RESPONSE:";            ' display raw status response
    FOR i = 1 TO 16
        PRINT Response(i); ",";
    NEXT i
    PRINT Response(17)
'display decyphered status using SystemStatus array
    LOCATE 8, 1
    PRINT "Input#", "Name                ", "Status "
    PRINT "-------------------------------------------------------------------"
    PRINT "   "; 1, "Shield Heat         ", SystemStatus(1, VAL(Response(3)))
    PRINT "   "; 3, "Atmosphere          ", SystemStatus(3, VAL(Response(5)))
    PRINT "   "; 4, "Foreline TC         ", SystemStatus(4, VAL(Response(6)))
    PRINT "   "; 5, "Chamber TC          ", SystemStatus(5, VAL(Response(7)))
    PRINT "   "; 12, "Side Shutter FB #2", SystemStatus(12, VAL(Response(14)))
    PRINT "   "; 13, "Side Shutter FB #1", SystemStatus(13, VAL(Response(15)))
    PRINT "   "; 14, "Top Shutter FB #2 ", SystemStatus(14, VAL(Response(16)))
    PRINT "   "; 15, "Top Shutter FB #1 ", SystemStatus(15, VAL(Response(17)))
    PRINT
    PRINT "Press a key to return to menu"
    CALL WaitKey(ak$)
RETURN

' This routine allows setting of the shutter positions.

SetShutterPositions:
    CLS
    LOCATE 23, 48
    PRINT "ESC - Cancel and return to menu"
    LOCATE 1, 1
    PRINT "Set Shutter Positions..."
    PRINT
    PRINT "Output#", "Name          ", "Position "
    PRINT "-------------------------------------------------------------------"
    PRINT "   12", "View Shutter", "1=closed, 0=open"
```

```
        PRINT "    13", "Top Shutter ", "0=closed, 1=filter, 2=open"
        PRINT "    15", "Side Shutter", "0=closed, 1=filter #1, 2=filter #2"
        PRINT
        PRINT "Enter Shutter Output#: 1";
        COLOR 23, 0
        PRINT "*";
        COLOR 7, 0
        LOCATE 9, 25
 GetOutputNumber:
        CALL WaitKey(ak$)
        IF flag = 2 THEN RETURN
        IF ak$ = CHR$(27) THEN RETURN
        ak = VAL(ak$)
        'make sure ak is 2,3 or 5
        IF (ak < 2 OR ak > 5) AND ak <> 4 THEN GOTO GetOutputNumber
        PRINT ak$
        n = ak + 10
        PRINT
        PRINT "Enter Shutter Position#: ";
 GetPositionNumber:
        CALL WaitKey(ak$)
        IF flag = 2 THEN RETURN
        IF ak$ = CHR$(27) THEN RETURN
        ak = VAL(ak$)
        'make sure they entered a zero and not a non-number character which would
        'result in ak being equal to zero
        IF ak = 0 AND ak$ <> "0" THEN GOTO GetPositionNumber
        IF ak > 2 THEN GOTO GetPositionNumber
        PRINT ak$
        P = ak
        CLS
        PRINT "Sending shutter #"; STR$(n); " to position #"; STR$(P); "..."
        CALL SendCommand("C1," + STR$(n) + "," + STR$(P))
        IF flag = 2 THEN RETURN
        CALL GetResponse(n)
        IF n = -1 THEN LOCATE 4, 1 : PRINT "Timeout! "
        GOTO SetShutterPositions
RETURN

' This routine tells the system to go to local control mode, and then exits
' to DOS.

ExitHC:
    IF NOT EOF(1) THEN CALL GetResponse(n)
    IF Response(1) = "R10" AND Response(2) = "0" THEN GOTO AlreadyLocal
    CALL SendCommand("C10, 0")
    CALL GetResponse(n)
    IF n = -1 THEN LOCATE 4, 1 : PRINT "Timeout!"
AlreadyLocal:
    CLS
    PRINT "Host Control Terminated."
    CLOSE #1
    END
```

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```
' Fill SystemError array with error messages,
' and fill SystemStatus array with stutus messages

SetErrorArray:
SystemError(0) = "Command not attempted, inhibited by system"
SystemError(1) = "Command completed successfully"
SystemError(2) = "Command not implemented"
SystemError(3) = "Coordinate check failure"
SystemError(4) = "Failed x axis starting condition check"
SystemError(5) = "Failed y axis starting condition check"
SystemError(6) = "Invalid die or array number"
SystemError(7) = "Cannot start x motion"
SystemError(8) = "Cannot start y motion"
SystemError(9) = "Timeout during x y movement"
SystemError(10) = "Motion aborted, x axis limit switch actuated"
SystemError(11) = "Motion aborted, y axis limit switch actuated"
SystemError(12) = "Cannot obtain x position"
SystemError(13) = "Cannot obtain y position"
SystemError(14) = "Final x position not correct"
SystemError(15) = "Final y position not correct"
SystemError(16) = "Failed z axis starting condition check"
SystemError(17) = "Cannot start z motion"
SystemError(18) = "Timeout during z motion"
SystemError(19) = "Motion aborted, z axis limit switch actuated"
SystemError(20) = "Cannot obtain z position"
SystemError(21) = "Final z position not correct"
SystemError(22) = "Feedback does not agree with output state within alloted
time"
SystemError(23) = "Setpoint not changed, value out of range or invalid"
SystemError(24) = "Tempature controller #1 access error"
SystemError(25) = "Tempature controller #2 access error"
SystemError(26) = "Tempature controller #1 setpoint readback error"
SystemError(27) = "Tempature controller #2 setpoint readback error"
SystemError(28) = "System not at vacuum"
SystemError(29) = "Shutter not implemented"
SystemError(30) = "No disk in drive #2"
SystemError(31) = "Disk is full"
SystemError(32) = "Disk is write protected"
SystemError(33) = "Cannot find file on disk"
SystemError(34) = "Miscellaneous disk error"
SystemError(35) = "Command not performed, communication test active"
SystemError(36) = "Miscelaneous parameter value error"

SystemStatus(1, 1) = "Temperature >= 300K"
SystemStatus(1, 0) = "Temperature < 300K"
SystemStatus(3, 1) = "= atmospheric pressure"
SystemStatus(3, 0) = "< atmospheric pressure"
SystemStatus(4, 1) = "Pressure <= setpoint"
SystemStatus(4, 0) = "Pressure > setpoint"
SystemStatus(5, 1) = "Pressure <= setpoint"
SystemStatus(5, 0) = "Pressure > setpoint"
SystemStatus(12, 1) = "At position"
SystemStatus(12, 0) = "Not at position"
SystemStatus(13, 1) = "At position"
SystemStatus(13, 0) = "Not at position"
```

```
SystemStatus(14, 1) = "At position"
SystemStatus(14, 0) = "Not at position"
SystemStatus(15, 1) = "At position"
SystemStatus(15, 0) = "Not at position"
RETURN

' This sub-program reads in the data in 'filename$' and returns it to the
' calling module in array().  It also return the number of data elements.
SUB GetMaps (filename$, array(), n)
    OPEN filename$ FOR INPUT AS #2    'open disk file for input
       i = 0
    DO WHILE NOT EOF(2)               'loop until End Of File is reached
     'get each number byte by byte
       DO WHILE NOT EOF(2) AND a$ <> CHR$(13)
           a$ = INPUT$(1, #2)
           b$ = b$ + a$
       LOOP
       IF EOF(2) THEN EXIT DO
       a$ = INPUT$(1, #2)             'get LF that is after CR
       array(i) = VAL(b$)             'put number to array then
       i = i + 1                      'increment array index
       a$ = "": b$ = ""
    LOOP
    n = i - 1        'numberofelements = array index -1
    CLOSE #2
END SUB

' This sub-program waits for the "response" from the system.
' It puts the response in Response(), and returns the number of elements in n.
' (Response() is a global variable.)
' Also, it prints the error (if any) that is returned.
SUB GetResponse (n)
    IF n = -99 THEN flag1 = 1
    IF n = -9 THEN ESC = 1  ' flag for enabling escaping from this routine
    n = 1
WaitChar:
    IF EOF(1) THEN   'handle timout and ESC key
       D& = D& + 1
       IF D& > 440000 THEN n = -1: EXIT SUB
       IF ESC = 1 THEN ak$ = INKEY$: IF ak$ = CHR$(27) THEN CLS : END
       GOTO WaitChar
    END IF
    D& = 0
    IF n = 1 AND R$ = "" AND flag2 = 0 THEN 'make sure first character is an SO
H then
       a$ = INPUT$(1, #1)     'ignore it.
       IF a$ <> CHR$(1) THEN GOTO WaitChar
    END IF
    a$ = INPUT$(1, #1)  'get current character
    IF a$ = " " THEN GOTO WaitChar  'ignore spaces
 'handle CR
    IF a$ = CHR$(13) THEN Response(n) = R$: GOTO Check
```

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```
 'strip commas, and handle Response array
    IF a$ = "," THEN
        Response(n) = R$  'place current string in array
        n = n + 1         'increment array index
        R$ = ""           'clear current string
        GOTO WaitChar
    END IF
    R$ = R$ + a$    'add current character to current string
    GOTO WaitChar
Check:
  'see if system sent 'return to local' response and exit if so
    IF Response(1) = "R10" AND Response(2) = "0" THEN
        PRINT #1, ACK
        n = -2
        EXIT SUB
    END IF
    PRINT #1, ACK
 'print error
    LOCATE 6, 1
    IF LEFT$(Response(1), 1) = "R" THEN   'if response starts with "R" then
        PRINT SystemError(1)              'print "successfully completed"
    ELSE
        IF Response(2) <> "1" THEN PRINT "ERROR: ";   'else print the error
        PRINT SystemError(VAL(Response(2)));
        IF Response(2) <> "1" THEN st! = TIMER
WaitToSee:
            IF TIMER - st! < 3 THEN GOTO WaitToSee
        END IF
    END IF
    IF NOT EOF(1) THEN a$ = INPUT$(LOC(1), #1) 'clear possible junk in buffer
    st! = TIMER
delay:
    IF TIMER - st! < .5 THEN GOTO delay
END SUB

' This sub-program takes care of the initial handshaking between the system
' and the host computer.  It waits for the request from the system and then
' asks the user if he wants to go into host control mode.  If so then it
' send the "host ready" command to the system otherwise it sends the
' "host not ready" command.
SUB HandShake
GetResp:
    flag = 0  : CLS
    PRINT " Waiting for system request for host control..."
    n = -9      ' this is to tell 'GetResponse' to check for the ESC key
    CALL GetResponse(n)
    IF n = -1 THEN GOTO GetResp 'if timeout then keep waiting
 'if system sent "return to local" then keep waiting
    IF n = -2 THEN GOTO GetResp

 'if it's not the request then keep waiting
    IF Response(1) <> "R10" THEN GOTO GetResp
    CLS
    PRINT "Request for host control recieved. "
    PRINT : PRINT "Do you wish to begin host control (Y/N)?"
```

```
WaitYN:
    CALL WaitKey(ak$)
 'if system sent "return to local" then go back and wait
    IF flag = 2 THEN GOTO GetResp
    IF UCASE$(ak$) = "Y" OR ak$ = CHR$(13) THEN GOTO Continue
    IF UCASE$(ak$) <> "N" THEN GOTO WaitYN
    CALL SendCommand("C10, 0")    'send "host not ready"
    CALL GetResponse(n)
    GOTO GetResp
Continue:
    CALL SendCommand("C10, 1")    'send "host ready" command
    CALL GetResponse(n)
    CLS
    PRINT "Host control established."
END SUB

' This sub-program send the command in Cmd$ to the system and waits for
' an ACK, if it gets a NAK it resends the command.  After 3 tries it
' "gives up" and returns with flag set to 3 and prints 'bad command'
SUB SendCommand (Cmd$)
    LOCATE 6, 1 : PRINT SPACE$(79)
 'check for characters in the buffer and get them (if any)
recheck:
    IF NOT EOF(1) THEN
        a$ = INPUT$(1, #1)
        IF a$ = CHR$(1) THEN  n = -99 : CALL GetResponse(n)
   END IF
   IF NOT EOF(1) THEN GOTO recheck:
 'see if the character were the "return to local" response from the system
 ' if so then set flag to 2 and exit
    IF Response(1) = "R10" AND Response(2) = "0" THEN flag = 2: EXIT SUB
ReSend:
    PRINT #1, SOH; Cmd$; CHR$(13); CHR$(10)    'print SOH then CMD then CRLF
WaitChar1:
    IF EOF(1) THEN GOTO WaitChar1              'wait for a character
    a$ = INPUT$(1, #1)                         'get it
    IF a$ = CHR$(1) THEN flag = 2: EXIT SUB    'if its a SOH then exit
    IF a$ = ACK THEN GOTO GotACK
    IF a$ = NAK THEN
        n = n + 1
        IF n > 3 THEN
            LOCATE 4, 1: PRINT "Bad Command, not accepted after 3 tries."
            flag = 3
            a$ = INPUT$(LOC(1), #1)
            EXIT SUB
        END IF
        GOTO ReSend
    END IF
    GOTO WaitChar1
GotACK:
  'This is needed for when the "return to local" command is typed in manual
  ' host control mode... it sets flag to 2 so that the program knows to
```

```
    ' restart.
    IF LEFT$(Cmd$, 3) = "C10" THEN
        x = INSTR(3, Cmd$, ",") + 1
        IF x <> 1 THEN e = VAL(MID$(Cmd$, x, LEN(Cmd$)))
        IF e = 0 THEN flag = 2
    END IF
END SUB

' This sub-program waits for a key to be pressed.
' While doing so, it also checks to see if the system has sent a
' "going to local" command, and returns with flag set to 2.
SUB WaitKey (ak$)
WaitLoop:
    IF NOT EOF(1) THEN
        a$ = INPUT$(1, #1)
        IF a$ = CHR$(1) THEN    'if SOH in buffer then getresponse
            n = -99 : CALL GetResponse(n)
        END IF
    END IF
    IF Response(1) = "R10" AND Response(2) = "0" THEN flag = 2: EXIT SUB
    ak$ = INKEY$
    IF ak$ = "" THEN GOTO WaitLoop
END SUB
```

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Notes

Plaintiff's / Defendant's EXHIBIT 583
for identification
Witness H. Appleby
Dated 5/13/98
Page 158 of 187 Pages
By Dolores Calcagni CSR #9740

SOFTWARE CONFIGURATION:

OVERALL VERSION NUMBER..... AP1.10B (Model AP-1, Version 10, rev. B)
OVERALL VERSION NAME..... 'Universal Version', updated
DATE..... March 1, 1989

FILENAME	DESCRIPTION
AUTOEXEC.BAT	Initial program run at power-on. Transfers required files to the 'ram-disc'.
OL-NAMES	File containing the names & revisions of the various software modules used by the program. FACTORY SET, DO NOT CHANGE!
SW-FLAGS.00	File containing the USER PROGRAMMABLE software flags, which control various operational aspects of the software. FACTORY SET TO DEFAULT VALUES
SETUP62G.EXE	Setup program: Read 'system configuration' files & initialize software; HPIB bus setup & check-out; CY525 board setup & check-out; Make & save map coordinate files to 'C drive', or get from 'A drive' and transfer to 'C'
XYZ-63B.EXE	Xyz menu: setup of probe & wafer positions via manual control of x,y,z movements
MAP-62G.EXE	Map movement menu: die & array movements based on the map coordinate values
TEMP-62H.EXE	Temperature control menu: Cooldown & warmup control via the temperature controllers
SP-62G.EXE	Setpoint menu: programming access to the temperature controller setpoints, the map configuration parameters, and the probe limits.
RC-62G.EXE	Remote control menu: operator access to 'host control' of the system
HOST-62G.EXE	Host communication program: control of system by a serially connected host computer
SP.01	File containing the USER PROGRAMMABLE temperature controller setpoints, the map congiguration parameters, and the probe limits. FACTORY SET TO DEFAULT VALUES. Setpoints 'saved' in the SETPOINT MENU program are stored in this file.
swconfig.10b	April 17, 1989

SOFTWARE CONFIGURATION: (continued)

FILENAME	DESCRIPTION
XDIEMAP.00	File containing the USER PROGRAMMABLE map coordinate values for the x-axis map positions. If specified, 'setup' program makes this file - and loads it into the 'RAM' drive.
YDIEMAP.00	File containing the USER PROGRAMMABLE map coordinate values for the y-axis map positions. If specified, 'setup' program makes this file - and loads it into the 'RAM' drive.
ZDIEMAP.00	File containing the USER PROGRAMMABLE values for the z-axis offsets for each map position. The 'setup' program CAN NOT make this file.
ARRYMAP.00	File containing the USER PROGRAMMABLE map coordinate values for the array positions within each map position. If specified, 'setup' program makes this file - and loads it into the 'RAM' drive.
SW-TEST	Utility file used for 'test' purposes. Allows for the simulation and overriding of various items.
DIE1POS.00	File containing the USER PROGRAMMABLE map coordinates for the "die #1, array #1" position - for use with 'random' die maps.
CO-NAME.00	File containing the USER PROGRAMMABLE "company name" - used in the print-out 'header' and menu displays.
DEV-NAME.00	File containing the USER PROGRAMMABLE "device name" - used in the print-out 'header' and menu displays.
MISCINFO.00	File containing the USER PROGRAMMABLE "misc. information line" - used in the print-out 'header'.
TOPSHUT.00	Utility file used by the software ONLY. Contains the output & feedback states, including pinout assignments, for the 'top' shutter.
SIDESHUT.00	Utility file used by the software ONLY. Contains the output & feedback states, including pinout assignments, for the 'side' shutter.

DOCUMENTATION SUMMARY

CUSTOMER ..... Standard 'Universal' Version
OVERALL VERSION NUMBER AP1.10B
DATE..... April 17, 1989

I. HP150 SETUP & CONFIGURATION

USERPGM.___

USER-PROGRAMMABLE FILE SUMMARY
These documents contains the exact contents of all user-programmable files on the 'program' disc.

USERCONF.62B

SOFTWARE CONFIGURATION VIA "USER-PROGRAMMABLE' FILES
This document describes the "user-programmable" files and their use in configurating the software, defining the map configuration, and setting various setpoints.

PWRUPSUM.01E

INITIAL SET-UP PROCEDURE FOR THE HP150II COMPUTER
This procedure outlines the steps required to setup the HP150 before its use with the AP-1 Cryotest Station. Included also is a description of the procedure to produce additional disc copies.

150&HOST.01F

PROCEDURE FOR SETTING-UP THE HP150II COMPUTER FOR COMMUNICATION WITH A HOST COMPUTER
Detailed description of the settings required on the HP150 before it can communicate with a host computer, including diagrams of cabling requirements.

150&PRT.01E

PROCEDURE FOR SETTING-UP THE HP150II COMPUTER & THE HEWLETT-PACKARD THINKJET PRINTER
Detailed description of the settings required on the HP150 before it can operate with a Thinkjet printer.

DISCRAM.01C

PROCEDURE FOR SETTING UP THE HP150II COMPUTER "RAM DISK"
Description of the steps required to enable a "C" drive that is resident in RAM.

SETUPSUM.62A

SET-UP PROGRAM DESCRIPTION
This description summarizes the program activities which occur upon application of power to the HP150. Included in this description are examples of the crt and printer outputs which indicate the results of the tests on the HPIB bus and the CY525 printed circuit board. Also included is an example of the printout of the map coordinate data.

II. MENU DESCRIPTIONS

MAINDOC.01A — **MAIN MENU & COVER CONTROL**
General overview of main menu operation. Detailed description of cover operation.

XYZDOC.01A — **XYZ MANUAL MOVE MENU DESCRIPTION**
This document describes the stepping and/or slewing of the wafer and probe assemblies. This menu is also used to control the top, view, and side shutters. A description of the "theta" adjustment is also included.

MAPDOC.01A — **MAP MOVEMENT MENU DESCRIPTION**
Description of menu that allows movement to the various preprogrammed die and array map positions.

TEMPMENU.01A — **TEMPERATURE CONTROL MENU DESCRIPTION**
Description of menu which is used to control the initialization, cooldown, and warmup of the two temperature controllers. Control of the shield heater and the backfill valve is also described.

SETPTDOC.01A — **SETPOINT MENU DESCRIPTION**
Description of menu that is used to list, print, and/or change the current values of the temperature controller setpoints, the map configuration parameters, and the probe limits.

III. HOST CONTROL

RMTDOC.60A — **REMOTE MODE MENU DESCRIPTION**
Menu allows operator to initiate host control of the system. Description includes a listing of the conditions that must be satisfied before entry to the host control mode is allowed.

COMMSPEC.01K — **COMMUNICATION SPECIFICATIONS, HP150 TO HOST COMPUTER**
This document outlines the details of host communication with the HP150. It includes specifications and a description of the control characters, message formats, general protocol, message structures, and various reference tables.

REMEXAM.01I — **COMMAND EXAMPLES, HOST COMMUNICATION**
This document contains crt display examples for all host commands.

III. HOST CONTROL (cont.)

PROTOCOL.01D — **APPENDIX A: COMMUNICATION PROTOCOL**
This document is essentially part of the communication specification which is described above. It is a detailed explanation of the communication protocol between the HP150 and the host computer. Included also are flow charts which detail all aspects of the protocol.

HOSTSIMA.DOC
HOSTSIMA.BAS — **HOST SIMULATION DESCRIPTION**
This document describes the operation of the 'host simulation' program - which runs on an IBM compatible computer. The 'source code' is also included. The program may be used as a 'starting point' in the development of a host control program.

IV. WAFER & PROBE SETUP PROCEDURES

P&WSETUP.03L — **PROBE AND WAFER SETUP PROCEDURE**
This procedure outlines the steps required to setup the probe and wafer positions prior to a "test cycle".

QWICKSET.01C — **QUICK GUIDE TO SETTING XYZ POSITIONS**
This document quides the user through the steps required to set the probe 'zero', 'test', & 'clear' positions and the wafer 'die #1, array #1 position

Z-MAPSUM.60A — **Z-MAP DESCRIPTION**
This description summarizes the special considerations involved when there are different z-axis elevations across the wafer surface

V. MISC. REFERENCES

SWCONFIG.10B — **SOFTWARE CONFIGURATION SUMMARY**
This document contains a list of all 'default' data files and software, including rev. level, contained on the 'program' disc.

PINOUT.02Q — **PINOUT CONNECTION LIST**
This list summarizes all connections to the CY525 motor driver board installed in the HP150 from the AP-1 Cryotest Station.

V. MISC. REFERENCES (cont.)

TEMPSWIT.02B	**TEMPERATURE CONTROLLER SWITCH SETUP SUMMARY** This document is used to set the rear-panel switch settings on the Lake Shore temperature controllers.
CIB.07B	**COMPUTER INTERFACE BD. - CIRCUIT DESCRIPTION** This document contains a functional description of all circuitry contained on the computer interface board. It is designed to aid in trouble-shooting problems relating to system input and output.
SHUTFILE.11A	**THE TOP & SIDE SHUTTER FILES** A summary of the special files that define the shutter ouput states, feedback states, and pinout assignments of the two '3-position' shutters.
SWTSTDOC.01A	**THE 'SOFTWARE-TEST' FILE** A summary of a special programmablle file that is typically used for test and software 'patch' purposes.
TRI-MDRV.01A	**THREE-MOTOR DRIVER BD. - FUNCTIONAL DESCRIPTION** A description of the board which buffers the signals from the computer interface bd. and converts these signals into 4-phase driver signals for the stepper motors.

PINOUT CONNECTION LISTS

These lists describe the connections to the CY525 motor drive board, which is installed in a card slot in the HP150.

CONTROL OUTPUTS (see note 1)

pin #,	cy525 J2 connector port #, bit #	name & description
57	1, 1	input group select (1=B group, 0=A group)
55	1, 2	backfill valve (1=open, 0=closed)
50	1, 3	chamber lid down (1=on, 0=off)
74	1, 4	chamber lid up (1=on, 0=off)
73	1, 5	shield heaters (1=on, 0=off)
35	2, 3	top shutter, control #2 (1=actuated)
16	2, 2	master enable (1=enable, 0=disable)
32	2, 1	Alarm (1=on, 0=off) (see note 2 for alternate use)
15	2, 4	xy motor power cntrl (1=full, 0=standby pwr)
14	2, 5	spare 5
23	3, 1	spare 6
25	3, 2	view shutter (1=in, 0=out)
5	3, 3	top shutter, control #1 (1=actuated) (2-pos. ctrl)
24	3, 4	side shutter, control #2 (1=actuated)
4	3, 5	side shutter, control #1 (1=actuated)

STATUS INPUTS (see note 1)
(all inputs are "active low" signals, except where indicated by (AH)

pin #,	cy525 J2 connector port #, bit #	name & description
56	1, 1	shield heat switch (at temp >= 300 K) (AH)
76	1, 2	pos. sw., left ind., x-axis home (PI1)
75	1, 3	atmosphere switch (at pressure => atmos.)
53	1, 4	foreline thermocouple setpoint switch
77	1, 5	chamber thermocouple setpoint switch
33	2, 2	lid up switch (at up position)
		(active only if "up" cntrl on)
12	2, 1	lid down switch (at down position)
		(active only if "down" cntrl on)
13	2, 3	pos. sw., left ind., y-axis home (PI1)
37	2, 4	x-theta, retract (at -x extreme position)(PI5)
34	2, 5	pos. sw., left-limit pos., x-axis (PI3)
21	3, 1	pos. sw., left-limit pos., y-axis (PI3)
42	3, 7	z-direction (low if 'moving' down,"-")(from CY525 chip)
60	3, 2	B: up-limit switch // A:side shutter feedback #2 switch
44	3, 3	B: 'spare' input // A:side shutter feedback #1 switch (see note 3 for alternate use of 'spare' input)
63	3, 4	B: "wafer access lid" open(AH)//A:top shutter feedback #2 switch (2-pos fb)
47	3, 5	B: "theta engagement" // A:top shutter feedback #1 switch

PINOUT CONNECTION LISTS

MOTOR I/O's

pin #, cy525 J2 connector	name & description
x-axis, y-axis, z-axis	(all inputs are "active low" signals)
72, 22, 8	spare outputs(3)
38, 26, 49	"wait" input, home switch input [x & y : NOT(PI1 OR PI2)] [z: 'internal' just-touching]
17, 6, 67	step inhibit input, no connection
18, 27, 66...(note 1)	"do-while" input, +-limit pos. sw.(PI3 OR PI4)
36, 7, 48...(note 1)	"abort" input, +-limit pos. sw.(PI3 OR PI4)
11, 41, 64	motor stepper drive #1 (phase B)(used on z-axis)
31, 65, 61	" " " #2 (phase D)(" " ")
10, 46, 62	" " " #3 (phase C)(" " ")
9, 2, 43	" " " #4 (phase A)(" " ")
29, 3, 45	step output (clock, x & y axis only)
30, 28, 42	direction output (high = "+", "cw")(x & y only)
54, 71, 51	cw step output (not used)
69, 52, 70	ccw step output (not used)
58, 1, 20	ground
78, 19, 40	"
68, --, --	+ 5 volts (DO NOT USE !)

note 1 : "do-while" & "abort" inputs of each axis are jumpered together, i.e. 18 & 36, 27 & 7, 66 & 48

extreme limit switches(+ & -) are "wired or'd" together

note 2: pin #32 alternate output (depending on system configuration): "going to 'just-touching' position" (1='going',0='not going') ONLY on systems specifically indicated.

note 3: pin #44 alternate input (depending on system configuration): "'external' 'just-touching' input indication" (0 = at 'just-touching', 1 = not at 'just-touching'). ONLY on systems specifically indicated.

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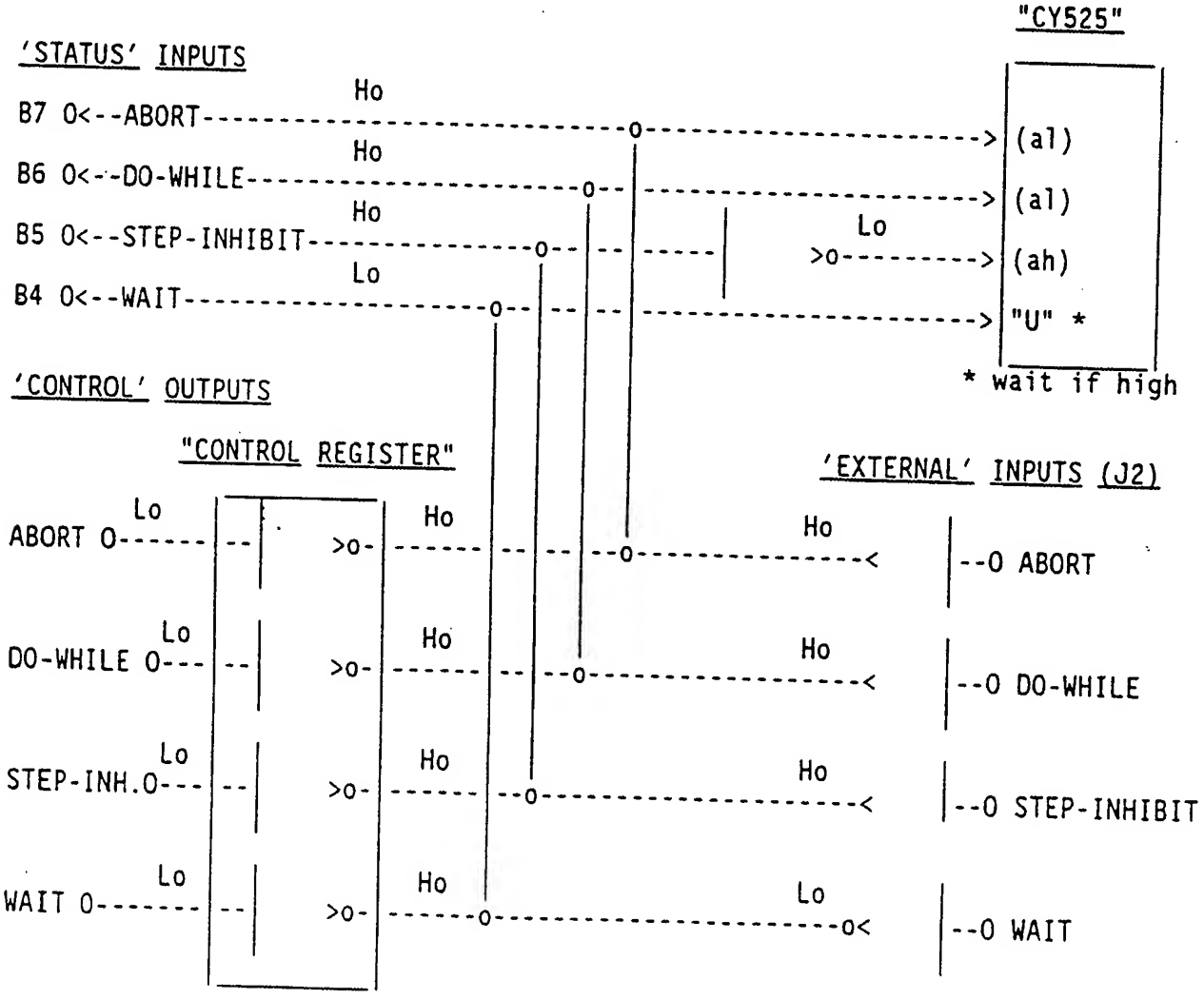
PINOUT CONNECTION LISTS (cont)

INPUT / OUTPUT CIRCUITRY ON THE CY525 BOARD

		@ INIT		DURING PGM RUN ("9")
B0	<---------- /BUSY	1		1
B1	<---------- /MOTION COMPLETE	0	("D")	0
B2	<---------- /RUN	1		0
B3	<---------- /SLEW	1		1
B4	<---------- WAIT	0		
B5	<---------- STEP INHIBIT	1	("E")	
B6	<---------- DO-WHILE	1		
B7	<---------- ABORT	1		

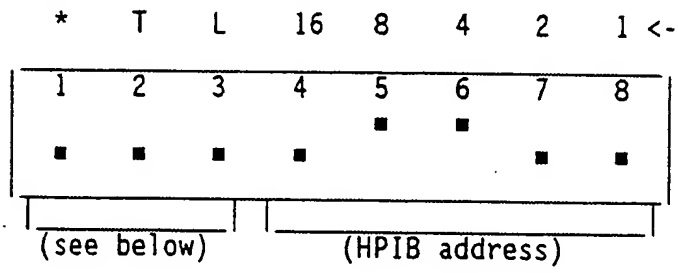


TEMPERATURE CONTROLLER SWITCH SETUP (MODEL 805)

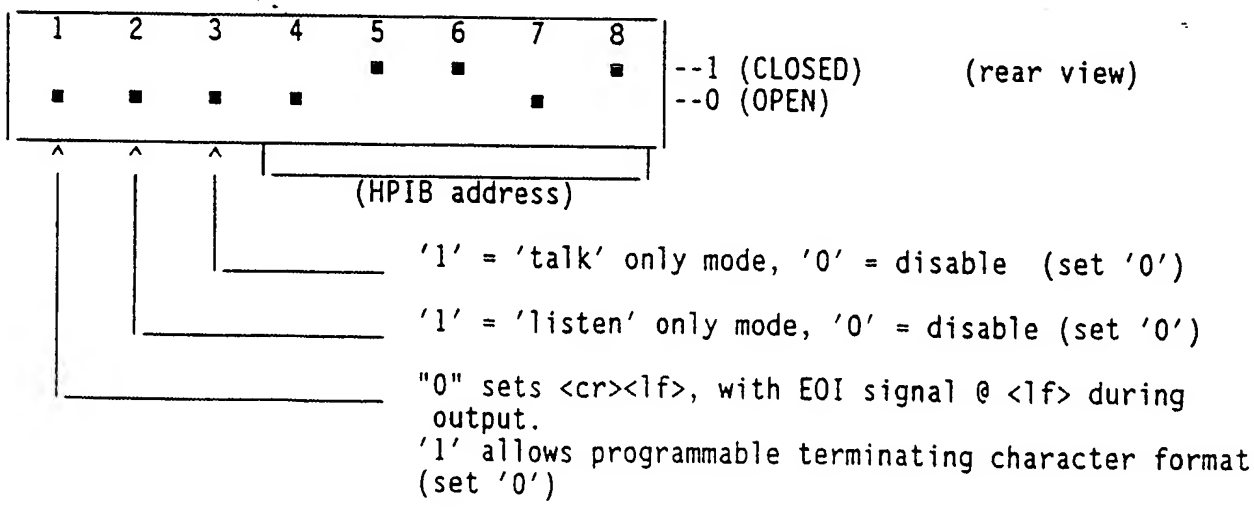
This procedure is used to setup the rear-panel switches on the Lake Shore Temperature Controller, Model 805. With this setup it is not necessary to run the AP-1 software to obtain correct temperature readings. However, the AP-1 software will remotely, through the IEEE-488 bus, program the A & B sensor id parameters (i.e. the curve selection).

The curve selections sent to the temperature controllers via the IEEE-488 bus are not necessarily the same as those determined by the switch settings shown in this document. However, the HP150 'setup' program prints the 'sensor id' values that are sent down to the temperature controller during the 'initialization' process - which is activated in the 'TEMPERATURE CONTROL' menu.

IEEE-488 ADDRESS SWITCHES (TEMPERATURE CONTROLLER #1, address=12)

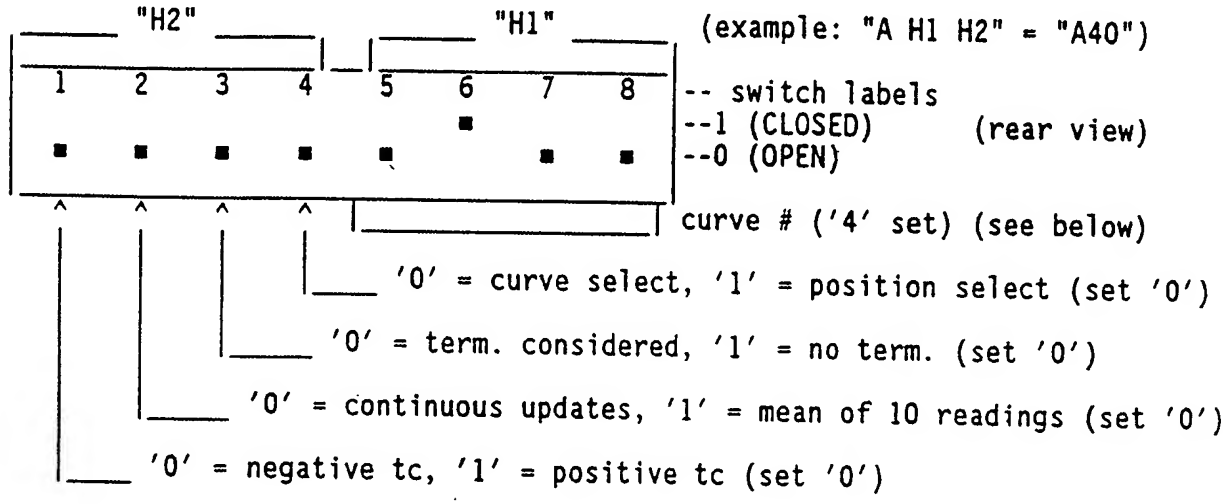


IEEE-488 ADDRESS SWITCHES (TEMPERATURE CONTROLLER #2, address=13)

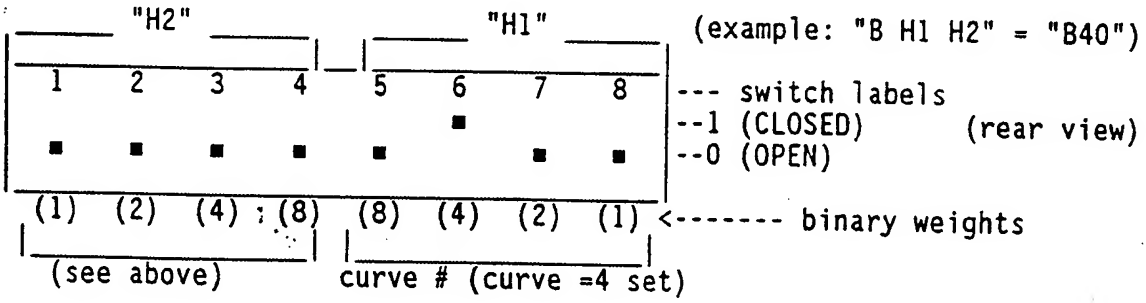


TEMPERATURE CONTROLLER SWITCH SETUP (MODEL 805)

SENSOR ID SWITCHES (TEMPERATURE CONTROLLER #1 & #2, SENSOR 'A')



SENSOR ID SWITCHES (TEMPERATURE CONTROLLER #1 & #2, SENSOR 'B')



CURVE # VS. CURVE TYPE

curve #	curve type
0	DRC-D
1	DRC-E1
2	CRV-10
3	DIN-PT
4	CRV=10 (extended)
5-15	prec. options

CONTROL SENSOR SELECT:

This switch should be set to select sensor A as the 'control' input signal.

Computer Interface Board - Functional Circuit Descriptions

1.0 Introduction

The functional descriptions contained in this section are designed to give the user a general appreciation of the circuit operation of the computer interface board, such that the user would be reasonably equipped to troubleshoot a malfuntioning board.

2.0 Computer Interface PC Board

This board supplies the total interface between the HP150 computer system and the AP-1 Cryotest Station. This board "buffers" all output lines from the 150 and all input lines from the system. The board also contains some miscellaneous logic.

The schematic drawing for the computer interface board is drawing # 02860, sheets 1 & 2. Copies of these drawings are contained with this document and are referred to frequently.

2.1 General Electrical Nature of System Inputs

Most inputs from the system are "active low". This means that the signal condition is "true" i.e. "active" when the signal line is at 0 volts. The opposite state for these input lines is typically an open line. However, all input lines that are "open" when inactive will have a voltage applied to them due to a "pull-up" resistor to +5V on the computer interface board. The input signal is therefore made compatible with the TTL circuits on this board.

There a number of input lines that are at +24V when in one state, and "open" when in the opposite state. This is exactly opposite to those lines described above. In these cases, an input voltage-limiting circuit is installed between the input connection and the TTL circuits on this board. There is an input voltage-limiting circuit on the shield heat, lid up, lid down, and wafer access lid input lines. A typical voltage limiting circuitry is composed of resistors, R7 and R6 and zener diode CR1. These can be found in the upper left hand corner of sheet #1 of the computer interface schematic. Functionally, R7 limits the current through the zener diode CR1. CR1 clamps the voltage to the TTL circuit to a maximum of 4.7V. The resistor R6 is used to "pull-down" the voltage to the TTL circuit to 0 Volts when the the system input line is open.

Computer Interface Board - Functional Circuit Descriptions

2.2 Chamber Lid Inputs

The chamber "lid up" and "lid down" inputs to the HP150 computer are "active low" signals. These signals will remain low only for the period of time needed by the computer to recognize the active low state and turn off the corresponding motor driver control signal. The state of the chamber "lid up" and "lid down" signals from the system will be open (lines pulled up to +24V) when "moving" to the desired position and will go to a "low" state (0 volts measured) when the movement achieves the desired position. However, as soon as the HP150 recognizes that the movement is completed, the state of these system input lines will return to an "open" condition.

2.3 Pressure Status Inputs

There are 3 input lines associated with the system pressure. These are "at atmosphere", "foreline thermocouple setpoint", "chamber thermocouple setpoint". These 3 lines are active low. That is, they are at 0 volts when the condition indicated by their name is "true". They are at +5V (i.e. open) when the condition is "not true". As can be seen by examining the schematic, these 3 input lines pass through TTL buffers designated by U3. These LS244 buffers pass the signal, with no inversion, to the HP150 computer. These buffers are used for most of the other signal lines connected to the HP150.

2.4 Shield Heat Indication Input

This system input line is at +24V when the shield temperature is greater than 300K. As explained above, the +24V is clamped to +4.7V at the input to the LS244 buffer chip. Therefore the output of this chip will be at an "active high" level (+5V) whenever the temperature >300K.

2.5 Shutter Position Feedback Inputs

These system inputs are switched to "ground" when the corresponding shutter is in the desired position. The inputs are "open" when the shutter is not in position. The voltage level on these "open" lines will, however, be at +5 volts due to the "pull-up" resistors. These shutters inputs are connected to a LS157 multiplexor circuit which under software control selects either the 4 inputs labeled A or the 4 inputs labeled B. This multiplexor circuit allows 8 input lines to share 4 lines to the HP150. When examining the state of the multiplexor outputs, i.e. the inputs to the 150, one must take care to examine the state of the multiplexor select line pin #1 which controls which group of 4 inputs will be presented to the HP150.

2.6 Wafer Access Lid Position Indication

This input is at +24V whenever the wafer access lid is in the up position. Strictly speaking, the input is at +24V whenever the lid is NOT in the fully down position. This input is "open" when the lid is in the down position - However, the voltage will be at 0 volts due to the "pull-down" resistor R12.

Computer Interface Board - Functional Circuit Descriptions

2.7 Probe Assembly "Home" Position

This system input is active low whenever the probes are in their fully-up position, as indicated by a microswitch contact.

2.8 Theta Adjustment Inputs (2)

The "theta engagement" input is active (low) whenever the theta-adjustment ball and socket are in electrical, i.e. mechanical, contact. The "theta position" input is active (low) whenever the wafer stage is at its extreme left-most (-X axis) position. This position corresponds to the theta-adjustment ball centered within its socket. The "theta position" indicator corresponds to the "PI5" photo-interruptor shown in the x-axis diagram on the following page.

2.9 Just-Touching Indication ('internal' indication) (see note 1)

This input is low whenever the probes are "just-touching" the wafer surface. The process for achieving this signal will vary from one application to another. The "inactive state" for this line may be either a +5V signal or an open line. The "active" state for this line must be at zero volts. If the "just-touching" function is not used, the line may be left open - however 'grounding' the line will inhibit any movement to the 'just-touching' position.

2.10 Wafer "Home" Indicators

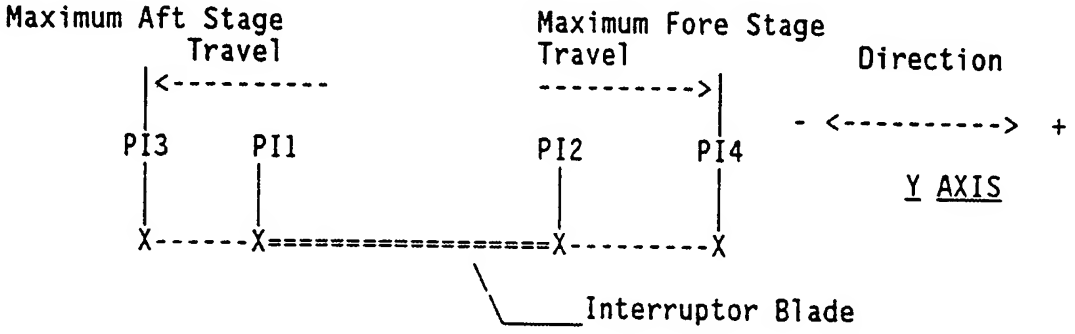
There is a set of two photo-interrupters switches on both the x and y axes which are used to establish the "home" position of the wafer. The two switches are spaced apart just slightly farther than an interrupting flag attached to the stage mechanism. The wafer is at its home position when the flag is exactly centered between the two switches, but not interrupting either. If the wafer is to the "left" of home position, the "left-home" switch will be interrupted. Similiarly, if the wafer is to the right of home position, the "right-home" switch will be interrupted. Obviously, if neither switch is interrupted, the wafer is at its "home" position. These four switches (PI1 & 2 on each axis) are inputted to the "computer interface" board on pins J115-31, 33, 35, 37. The inputs from these photo-interruptors will be at zero volts when they are interrupted. As can be seen in the schematic and based upon preceeding information, the x and y home indication inputs to the HP150 will be active (low) when the "left-home" and the "right-home" inputs are both inactive i.e. not interrupted. The "left-of-home" indications (PI1) are also inputted to the HP150. With these two inputs, the HP150 computer can establish whether the wafer is at the home position, and if not, on which side of home.

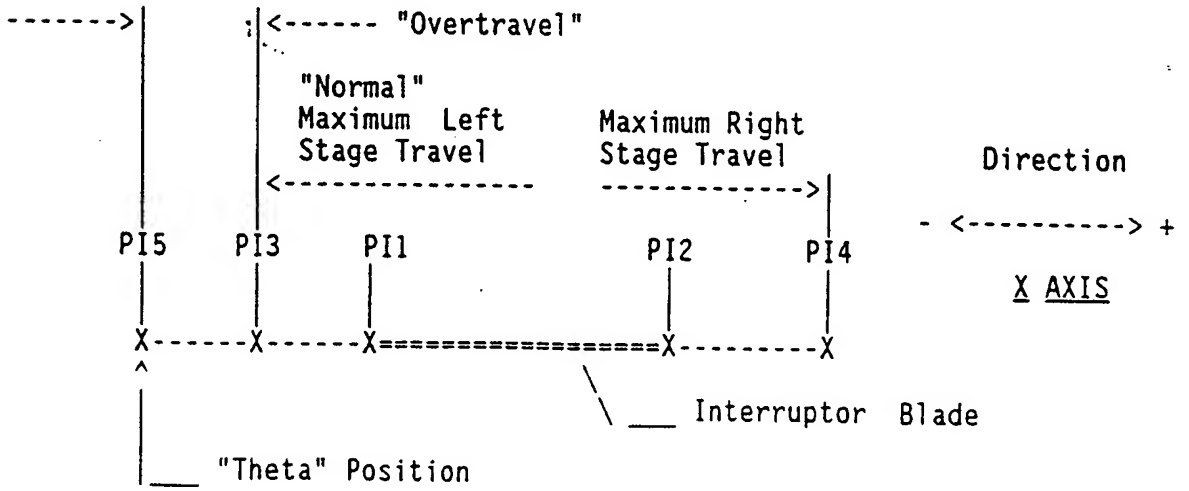
note 1: The input line on 'U1, 1B' may, depending on the system configuration, be used as an 'external' 'just-touching' input. In which case, the input state conditions are identical to those of the 'internal' 'just-touching' input.

Computer Interface Board - Functional Circuit Descriptions

2.11 X and Y Axis Photo-Interruptor Position Diagram

The following is a diagram of the photo interruptors that are positioned along the x and y axis. These photo-interruptors have an "open" output (i.e. +5V with board pull-ups) whenever they are NOT interrupted. Their output is at ground whenever they are interrupted. As can be seen from the diagram below, both the x and y axis have a limit switch (photo interruptor) associated with the extreme positions of travel. These two limit switches, on both axis, are brought into the "computer interface" board and combined together logically to produce an input to the HP150 which will be active (low) whenever one of the two limit switches is interrupted. This combined signal is used by the CY525 board to terminate movement in the associated direction. In addition, the "left-limit" interruptor state (interruptor state) (PI3) is inputted to the HP150 so that it can establish which of the two limit switches has been actuated.





Computer Interface Board - Functional Circuit Descriptions

2.12 Z Axis Microswitches

There are two microswitches positioned along the z axis. These correspond to the upper and lower limits of travel. The position associated with the upper switch is called the probe "home" position. The lower position switch is never activated since it corresponds to a probe position substantially lower than the surface of the wafer. In any case, the two limit switches (which are "active low") are brought from the system to the "computer interface" board and combined together to produce one "active low" input to the HP150 computer which indicates that the probes are at either limit switch. The "home" limit switch is also connected to a input to the HP150 computer.

2.13 Shutter Control Outputs

The shutter control output lines are "active high" from the HP150. They are buffered, and inverted, on the "computer interface" board so they may drive remotely mounted +24V solenoid valves which are pneumatically coupled to the actual shutter mechanisms. The control lines from the HP150 are "high" (+5v) when the corresponding mechanism must be "actuated". They are "low" (0v) when the mechanism must NOT be "actuated".

2.15 Backfill Valve Control Output

The control line from the HP150 is active high (+5 volts) when the backfill valve is open. The signal to the system is at 0 volts when the backfill valve is open. The backfill valve is typically used to fill the chamber with dry N2 to bring the system up to atmospheric pressure.

2.16 Shield Heaters Control Output

This output from the HP150 is at +5 volts when the shield heaters are turned on. The shield heaters are composed of two long assemblies mounted underneath the shield assembly. These heaters are turned on under control of the HP150. They are turned off by means of a +85 F thermostat mounted on the shield assembly, or by the HP150 operator.

2.17 Alarm / "Going to the 'Just-Touching' Position" Output

This output is normally reserved for an 'alarm' output - activated by a remote host computer. Depending on the system configuration, it may be used to indicate that the probes are in the process of 'going to the just-touching position'. The output to the system is 'active low' (at ground) during this process.

Computer Interface Board - Functional Circuit Descriptions

2.18 Chamber Lid Control Outputs

There are two chamber lid control lines from the HP150. One output enables upward movement while the other enables downward movement. These signals are at +5 volts when enabled. The corresponding outputs to the system are at 0 volts when enabled. There is special circuitry connected to the two chamber control lines that prohibit both outputs from being active at the same time.

2.19 Master Enable Output

This output from the HP150 is at +5 volts when active. The output to the system is at 0 volts when active. This control line becomes active, if and only if, the software successfully executes the "setup" program. The activation of this output enables the application of power to various system assemblies.

2.20 XY Motor Standby Power Control Output

This output from the HP150 is at 0 volts when active. The output to the system is also at 0 volts when active. This control is used to reduce the xy motor voltage to a "standby" level when xy movement has not occurred for a period of one minute. This action minimizes the heat buildup in the xy motor actuator assemblies - thereby increasing their reliability.

2.21 X and Y Axis Step Control Signals

The step control signals from the HP150 are functionally identical for both x and y axis. The "step pulse" output from the HP150 is used to increment the stepping motor through one "half-step". The "direction" output is used to control the stepping direction. The "+" direction (i.e. to the "right" on the x axis and "towards" from the operator on the y axis) is indicated by a +5 volt signal on the direction control line from the HP150. The "step pulse" and the "direction" signals are connected to a special "motor driver" pc board. This board converts the "step pulses" to "4-phase", "half-step" output signals which are connected through motor drivers to the stepping motors. This motor driver board is explained in a separate document.

When the operator is using the "slew keys" on the "xyz" menu, the pulse period of the "step pulse" signal will vary from 1.5 ms to 10 ms as the "slew rate" varies from "fast" to "slow". The corresponding frequency will vary from approximately 666 steps per second to 100 steps per second. The "step" signal itself, when the operator is "slewing" the motor, is a "negative" pulse with a width of 60 us.

Computer Interface Board - Functional Circuit Descriptions

When the HP150 is moving the x or y axis motor from one absolute position to another, the frequency of the "step pulse" will typically be 800 steps per second. The step signal will then be a positive pulse with a period of 2.5 us.

When the HP150 is attempting to "back off" a limit switch, the "step pulse" signal will be a burst of 50 steps maximum. These steps will be negative pulses with a pulse width of 50 us.

2.22 Z Axis Step Control Signals

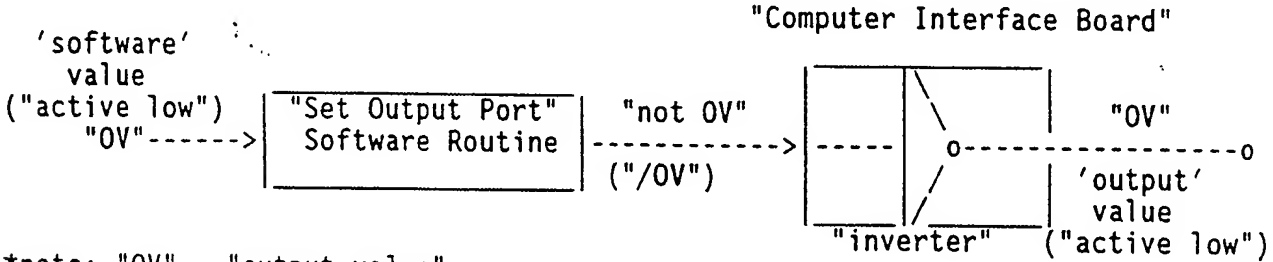
The motor control outputs from the HP150 associated with the z axis motor are the four "phase - control" lines that are used to supply a "full-step" sequence to the z-axis stepping motor. These four lines are active high from the HP150. They are active low to the system. When all four lines from the HP150 are low, there are no phases actuated in the z-axis stepper motor. These four control lines are connected to a special z-axis "driver" pc board before they are connected to the stepper motor.

2.23 +5 Volts Voltage Regulator

The 5 volt regulator VR1 is used to convert +8 volts to the required +5 volts needed by the TTL logic circuits on the "system interface" board.

3.0 Output Bits: Inversion Scheme (Reference)

The following diagram summaries the various 'inversions' in the state of the output bits - from the levels specified in the software to the level which drives the output.



*note: "OV" = "output value"

As can be seen, the net effect is that there is NO inversion from the 'software' level to the 'output' level.

The bit values specified in the 'shutter files' correspond to the 'software' value, thus correspond also to the 'output' value.

ADDENDUM: THE 'TOP' & 'SIDE' SHUTTER FILES

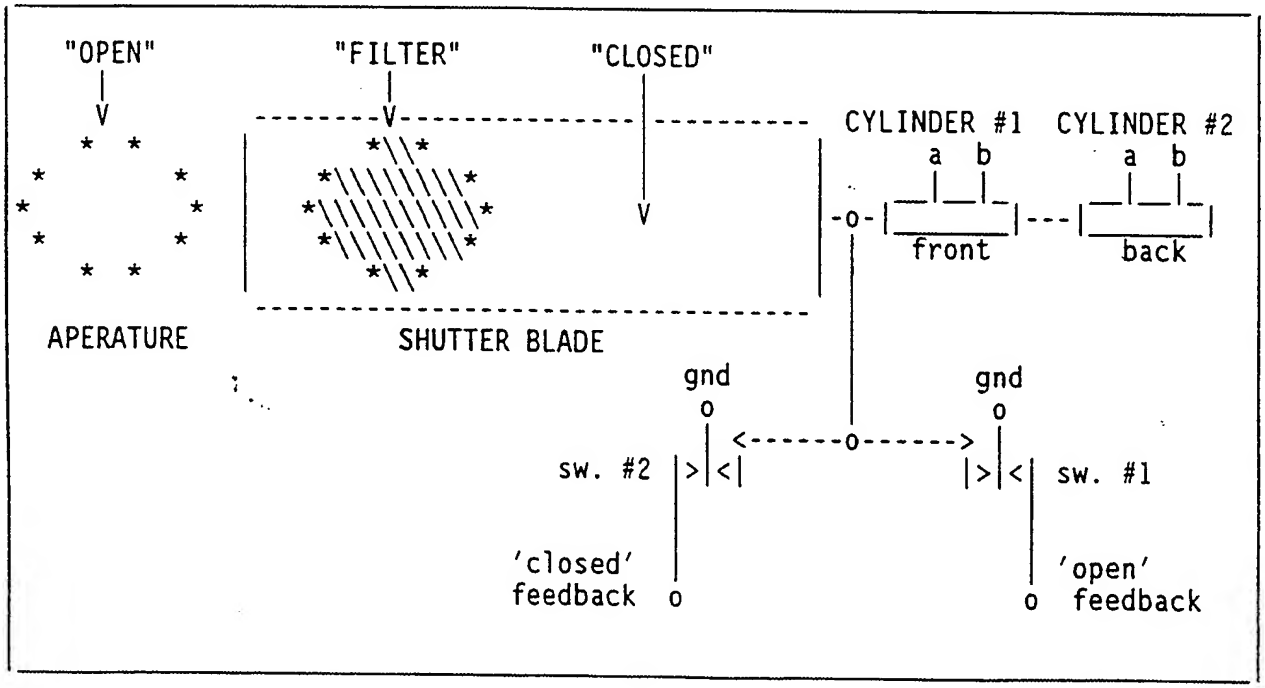
The 'shutter' files are used to define the specific states of the two output control lines - for each of the three positions that the top & side shutters may assume. The files also define the corresponding state of the two feedback inputs for each of these three positions.

In addition, these shutter files are used to define the pin assignments for the output control lines(2) and the feedback input lines(2).

If a particular shutter is not implemented, the first item in these files is set to "zero". The software program will give an appropriate message to the operator when shutter operation is attempted on a 'non-implemented' shutter.

These files are pre-programmed and MUST NOT be changed by the user !!

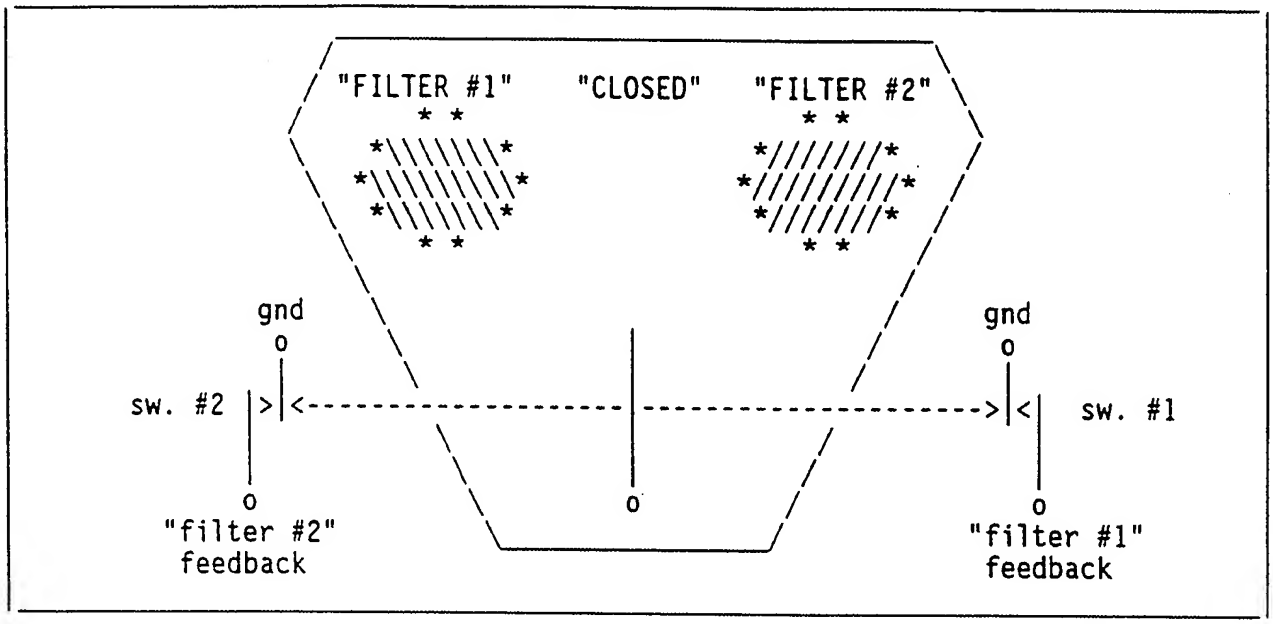
TOP SHUTTER MECHANISM:



notes:
(1) no 'filter' or 'closed' position is allowed if the 'wafer access lid' is up
(2) 'open' is the power-up default position, ie. both cylinders 'retracted'
(3) 'filter' position is obtained with one cylinder 'extended'.
(4) 'closed' position is obtained with both cylinders 'extended'.

ADDENDUM: THE 'TOP' & 'SIDE' SHUTTER FILES (cont.)

SIDE SHUTTER MECHANISM:



note:
(6) The power-up default position is 'closed'

SIDE SHUTTER OUTPUT & FEEDBACK STATE DIAGRAM:

State Name	Host State Number	Output State(5) #1	Output State(5) #2	Feedback State(5) #1	Feedback State(5) #2
'FILTER #2'	"2"	9 "1"	10 "0"	11 "1"	12 "0"
'FILTER #1'	"1"	5 "0"	6 "1"	7 "0"	8 "1"
'CLOSED'	"0"	1 "1"	2 "1"	3 "1"	4 "1"

notes:
(5) "0" = 'active' state in software (simulator note: 1=light on, 0=light off)

ADDENDUM: THE 'TOP' & 'SIDE' SHUTTER FILES (cont.)

THE 'COLD SHUTTER'

The following data is given to specify the necessary information required to re-configure the 'top' shutter into a "2-position" (ie. "closed/open") 'cold shutter' that existed in systems with software versions 1.06A and earlier.

COLD SHUTTER OUTPUT & FEEDBACK STATE DIAGRAM: (note 8)

State Name	Host State Number	Output State(5) #1 (note 7)	Output State(5) #2 (note 7)	Feedback State(5) #1	Feedback State(5) #2	
'OPEN'	"2"	9 "1"	10 "1"	11 "1"	12 "1"	
N/A (disabled)	"1"	5 "1"	6 "1"	7 "0"	8 "1"	impossible <--feedback condition
'CLOSED'	"0"	1 "0"	2 "0"	3 "0"	4 "0"	

note (5): "0" = 'active' state in software (simulator: 1=light on, 0=light off)
note (7): The indicated lines do not have a corresponding pin assignment
note (8): A "0" is the 'active' state for both output as well as input.

COLD SHUTER PINOUT ASSIGNMENT DIAGRAM:

Pin Assignment	Output (11) #1 (note 7)	Output #2 (note 7)	Feedback #1	Feedback (10) #2
Port #	13 "3"	15 "3"	port 3	port 3
Bit #	14 "3"	16 "3"	17 "4"	18 "4"

notes:
(10) port 3, bit 4=old 'cold shutter' feedback input, pin 63 (v1.06a & earlier)
(11) port 3, bit 3=old 'cold shutter' control output, pin 5 (v1.06a & earlier)

THE "SOFTWARE TEST" FILE

The "software test" file is used to modify the operation of the software for purposes of program testing or to temporarily override specific interlocks in the software. The name of this file is "SW-TEST".

This file is typically NOT supplied on the "program" disk when the system is shipped. And in those cases where this file IS resident on the "program" disk, the use of this file is typically disabled. However, when this file is enabled, a special "addendum" is inserted in the "HP150 Manual" which describes the specific conditions enabled or disabled by this file.

At the present time there is only one flag in this file that potentially could be used by a customer. This flag is the "atmosphere override" flag. For purposes of completeness, this document lists the function of all currently assigned flags. THE USER MUST NOT ENABLE ANY FLAG OTHER THAN THE "ATMOSPHERE OVERRIDE" FLAG. The atmosphere override flag allows for downward probe movement when the system is at atmosphere - a condition not normally allowed.

In general, to activate a function controlled by the "software test" file, the flag is set to "1". A "0" will disable the corresponding function.

The "software test" file is organized as follows:

Flag #	Name	Description
1.	TEST.TC	0 = Normal, 1 = Simulate Temperature Controllers
2.	NO.CY525	0 = Normal, 1 = No CY525 board installed, bypass calls
3.	CYTEST	0 = Normal, 1 = Extend CY525 test and associated printouts
4.	INC.MAX.RATE	0 = No change, value x 100 = incremental change in the "hard-coded" max rate.
5.	ATMOS;OR	0 = Normal, 1 = ignore ATMOS switch input while in the XYZ and MAP menus
6.	spare	(set to 0)
7.	spare	(set to 0)
8.	spare	(set to 0)

When the "software test" file is required, and to eliminate the possibility that the user may set the wrong flag in this file, pre-made "software test" files are available on the disk for use by the customer.

To have the atmosphere switch ignored in the XYZ and MAP menus, the pre-made "SW-TEST.ATM" file is copied to the "SW-TEST" file, i.e. the "SW-TEST" file is replaced by the "SW-TEST.ATM" file. The "SW-TEST.ATM" file has all flags set to "0" except flag #5, which is set to a "1".

The pre-made "SW-TEST.00" is copied to the "SW-TEST" file to set ALL software test flags back to normal.

THREE MOTOR DRIVER - FUNCTIONAL CIRCUIT DESCRIPTION

This printed circuit board is used to "buffer" the signals from the "computer interface" board and to convert these signals to "4 phase", "half-step" signals that are used to control the x and y axis stepper motors. The corresponding schematic drawing for this board is #S-02594.

This board is used only in conjunction with the x and y axis. The z axis stepper motor control lines come directly from the "computer interface" board. Therefore the z axis circuitry on this board is unused.

The circuitry for the x and y axis are identical. Therefore, only one axis is is explained in this document.

There are three control signals per axis from the "computer interface" board. The "clock" input is in reality the "step pulse" output from the "computer interface" board. The "enable" input, which is "active low", is tied to ground on the "computer interface" board. The "forward/reverse" signal from the "computer interface" board controls the stepping direction of the motor. The "forward" direction (active high) corresponds to a "-" direction, whereas a "reverse" direction (low) corresponds to a "+" direction. A "+" direction on the x axis is wafer movement to the right, while a + direction on the y axis is wafer movement away from the operator.

To minimize power dissipation, and to increase the noise margin of the circuitry, all integrated circuits on this board are of the CMOS type. Because the circuits are CMOS, care must be taken with respect to the proper handling of the board and its components during repair and troubleshooting. Repair personnel working with this board MUST wear a grounding strap and use a "grounded-tip" soldering iron.

All input signals have an RC filter circuit between the input connection and the circuitry on this board. The output from these filters are buffered with CMOS schmitt triggers (p/n 74C14).

All CMOS circuitry on this board uses +5v. A three terminal regulator mounted on this board converts the +8v from the card-edge connector to the required +5v

Each axis has an up/down binary counter which counts from 1 to 8 and then back to 1 again. These counters use the "forward/reverse" input line to control the count direction. They use the "clock" input line as their count input.

The outputs from the binary counter, along with the "forward/reverse" and "enable" inputs, are directed to drivers (p/n 4049) which light LEDs mounted at the edge of the board. These LEDs are used as troubleshooting aids.